

# **Environmental Security Technology Certification Program (ESTCP)**

## **Technology Demonstration Plan**

### **MTADS Airborne and Vehicular Survey of Target S1 at Isleta Pueblo**

**Albuquerque, NM**

**17 February - 2 March, 2003**



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# **MTADS Airborne and Vehicular Survey of Target S1 at Isleta Pueblo**

**Albuquerque, NM**

**17 February - 2 March, 2003**

## **1. Introduction**

### **1.1 Background**

Buried unexploded ordnance, UXO, is one of the Department of Defense's most pressing environmental problems. Not limited to active ranges and bases, UXO contamination is present at DOD sites that are dormant and in areas adjacent to military ranges that are under the control of other government agencies and the private sector.

Traditional methods for buried UXO detection, characterization, and remediation are labor-intensive, slow and inefficient. Typical detection and characterization methods rely on hand-held detectors operated by explosive ordnance disposal (EOD) technicians who slowly walk across the survey area. This process has been documented as inefficient and marginally effective.<sup>1</sup> In addition, a large portion, approaching 70% in some cases, of the total budget of a typical remediation effort is spent on digging targets that do not turn out to be ordnance.

The Environmental Security Technology Certification Program, ESTCP, has supported the Naval Research Laboratory in the development of the Multi-sensor Towed Array Detection System, MTADS, to address these deficiencies. The MTADS incorporates both cesium vapor full-field magnetometers and pulsed-induction sensors in linear arrays that are towed over survey sites by an all-terrain vehicle. Sensor positioning is provided by state-of-the-art Real Time Kinematic (RTK) GPS receivers. The survey data acquired by MTADS are preprocessed using tools from the Geosoft Oasis montaj suite and then targets are analyzed using an NRL-developed Data Analysis System, DAS. The DAS was designed to locate, identify and categorize all military ordnance at its maximum self-burial depth. It is efficient and simple to operate by relatively untrained personnel. The performance of the MTADS has been demonstrated at a number of prepared sites and live ranges over the past five years.<sup>2-12</sup> It can detect and locate ordnance with accuracies on the order of 15 cm.<sup>5</sup>

Many sites of interest have terrain that cannot be traversed on foot. Some sites, particularly on active ranges, are cluttered with a variety of ordnance that make clearance or even characterization activities potentially dangerous. Finally, there are many formerly used ranges dating from World War II (and earlier) that are located in areas involving tens or hundreds of thousands of acres with isolated bombing targets or impact ranges. Locations of many of these impact areas (or ordnance burial caches) are unknown or imprecisely located. Some of these areas are located on Native American reservations while others involve BRAC or pending BRAC sites.



To address these issues NRL, under ESTCP Project 200031, has developed and demonstrated an airborne adjunct to the *MTADS* vehicular and man-portable systems. This airborne system allows efficient and effective characterization of many of these areas that are inappropriate for vehicular surveys. It is designed to rapidly, economically, and efficiently survey large sites that are not appropriate for vehicular or man-portable surveys. While the airborne system is not capable of detecting the smallest classes of buried UXO at their maximum likely self-burial depths, it does allow efficient surveys of large areas to locate target bull's eyes, impact clusters, and burial caches. Under favorable conditions we can detect and characterize individual ordnance such as GP bombs and the projectiles larger than 60-mm mortars. For these individual ordnance targets, the system estimates burial depths, likely ordnance size, and provides for target way pointing, as well as creating GIS-compatible target output maps and sorted target tables.

The primary goals of the airborne *MTADS* Dem/Val program are enumerated below:

1. Field an airborne magnetometer array for efficiently surveying very large or inaccessible areas,
2. The system should have the capability to characterize the presence of UXO associated with impact bull's eyes or buried ordnance caches,
3. The airborne survey system will incorporate many of the successful developments associated with the vehicular *MTADS*, including sensors, satellite-based navigation, efficient data acquisition approaches, and the DAS suite of utilities for data manipulation and target analysis,
4. The system should create a permanent record in global coordinates of the positions of all targets, and
5. The intended use of this airborne automated technology is for site characterization of DoD bombing and target ranges. The system must be capable of efficiently and rapidly surveying relatively large areas typical of ranges used during and since WW II that occupy millions of acres.

## **1.2 Objective of the Demonstration**

This Demonstration has three primary objectives. First, we will demonstrate the airborne *MTADS* in a new geological environment against a new target set. Second, the probability of detection and location accuracy of the airborne system will be measured against the baseline vehicular system. The targets for this comparison will include the existing practice bombs as well as an emplaced target suite chosen by ESTCP. And, finally, the *MTADS* airborne system will be measured against the system developed and deployed by Oak Ridge National Lab. This intersystem comparison will quantify the performance features of each system and serve as a learning opportunity for both development groups.

## **1.3 Official DOD Requirement Statement**

The Navy Tri-Service Environmental Quality Research Development Test and Evaluation Strategic Plan specifically addresses under Thrust Requirements 1.A.1 and 1.A.2, the

requirements for improved detection, location and removal of UXO on land and under water. The index numbers associated with these requirements are 1.I.4.e and 1.III.2.f. The priority 1 rankings of these requirements indicate that they address existing statutory requirements, executive orders or significant health and safety issues. Specifically the requirements document states:

*There are more than twenty million acres of bombing and target ranges under DOD control. Of particular concern for the Navy are the many underwater sites which have yet to be characterized. Each year a significant fraction (200,000-500,000 acres) of these spaces are returned to civilian (Private or Commercial) use. All these areas must be surveyed for buried ordnance and other hazardous materials, rendered certified and safe for the intended end use. This is an extremely labor intensive and expensive process, with costs often far exceeding the value of the land.... Improved technologies for locating, identifying and marking ordnance items must be developed to address all types of terrain, such as open fields, wooded areas, rugged inaccessible areas, and underwater sites.*<sup>13</sup>

The MTADS addresses all aspects of the Tri-Service Requirements for land-based buried UXO. It is designed to survey large sites rapidly and efficiently, with commensurate economic benefits. Moreover, it is capable of detecting all classes of buried UXO at their likely self-burial depths. The system will correctly locate buried targets, determine their burial depths, classify the likely ordnance size, provide for future target way pointing, as well as create GIS-compatible target output maps and sorted target tables.

## **2. Technology Description**

### **2.1 Technology Development and Application**

#### **2.1.1 Vehicular Magnetometer System**

The MTADS hardware consists of a low-magnetic-signature vehicle that is used to tow linear arrays of magnetometer and pulsed-induction sensors to conduct surveys of large areas to detect buried UXO.<sup>14</sup> The MTADS tow vehicle, manufactured by Chenoweth Racing Vehicles, is a custom-built off-road vehicle, specifically modified to have an extremely low magnetic signature. Most ferrous components have been removed from the body, drive train and engine and replaced with non-ferrous alloys.

The MTADS magnetometers are Cesium-vapor full-field magnetometers (Geometrics Model 822ROV) selected for low noise and inter-sensor reproducibility. An array of eight sensors is deployed as a magnetometer array on an aluminum and composite platform, Figure 1. The sensors are sampled at 50 Hz and typical surveys conducted at 6 mph; this results in a sampling density of ~6 cm along track with a sensor spacing of 25 cm. The time-variation of the Earth's field is measured by a ninth sensor deployed at a static site removed from the survey area. These data are used to correct the survey magnetic readings.



Figure 1 – Vehicular MTADS magnetometer system deployed at the Badlands Bombing Range

The sensor positions are measured in real-time (5 Hz) using the latest Real Time Kinematic (RTK) Global Positioning System (GPS) technology which results in position accuracies of ~5 cm. All navigation and sensor data are time-stamped with Universal Coordinated Time (UTC) derived from the satellite clocks and recorded by the data acquisition computer (DAQ) in the tow vehicle. The sensor, position, and timing files are downloaded periodically throughout a survey onto magnetic disks and transferred to the Data Analysis System (DAS) for analysis.

### 2.1.2 Airborne Magnetometer System

The airborne *MTADS* system hardware includes an array of seven total field magnetometers mounted on a Bell Helicopter Model 206L series “Longranger.” The *MTADS* magnetic sensors are Cs vapor full-field magnetometers (a variant of the Geometrics 822 sensor, designated as the Model 822A). The helicopter with the magnetometer array mounted is shown in Figure 2. All sensors are interfaced to a data acquisition computer (DAQ). The DAQ electronics are contained in a rack mounted in the rear starboard seat position in the helicopter, Figure 3. The interface to the helicopter power and power distribution system is also in the rack, as are readouts for all the sensor inputs. The survey progress is monitored continually by an operator in the rear port seat.



Figure 2 – MTADS airborne magnetometer system deployed at the Badlands Bombing Range



Figure 3 – MTADS airborne DAQ mounted in the rear seat of the survey helicopter

In the 9-meter boom, the seven sensors are mounted with a 1.5 meter horizontal spacing. The specially-selected magnetometers, which are airborne quality, were acceptance tested at the manufacturer's facility to verify sensitivity, sensor noise, heading error, dead zones, inter-sensor compatibility, and performance with the multi-sensor interface modules.

The sensor positions above the surface of the Earth (latitude, longitude, and height above ellipsoid) are determined using satellite-based GPS navigation, employing the latest Real Time Kinematic (RTK) technology, which provides a real-time position update (at 20 Hz) with an accuracy of about 5 cm. GPS satellite clock time is used to time-stamp both position and sensor data information for later correlation.

The helicopter pilot flies the survey using an onboard navigation guidance display, Figure 4. The survey parameters are set up in a second computer that supports the pilot display. This computer shares the GPS navigation data with the DAQ. The survey guidance display provides left-right of track indicator, altitude indicator, an automatic line number increment, an adjustment for lateral offset, a color-coded flight swath overlay, and the ability to zoom in or out on the display. The survey course-over-ground (COG) is plotted for the pilot in real time on the display, as are presentations showing the data quality for the primary sensors and the GPS navigation fix quality. This allows the operator to respond to both visual cues on the ground and to the survey guidance display. Following a survey, the operator can survey any missed areas before leaving the site.



Figure 4 – Two views of the pilot guidance system

### 2.1.3 Data Analysis Methodology

For the vast majority of MTADS surveys, the MTADS Data Analysis System has been used to convert the sensor and position data files into an anomaly map by interpolating the individual sensor readings using the GPS-derived positions. The DAS software was developed specifically for the MTADS program as a stand-alone suite of programs. PC-based code is now available and has been used for recent operation. The DAS is written for use by both sophisticated and novice users. Even the novice can perform a complete anomaly analysis using menu-driven tools and default settings. For the advanced user, there is an extensive range of options available including navigation data cleanup, sensor nulling and leveling, noise filtering, etc. A working screen of the DAS is shown in Figure 5.

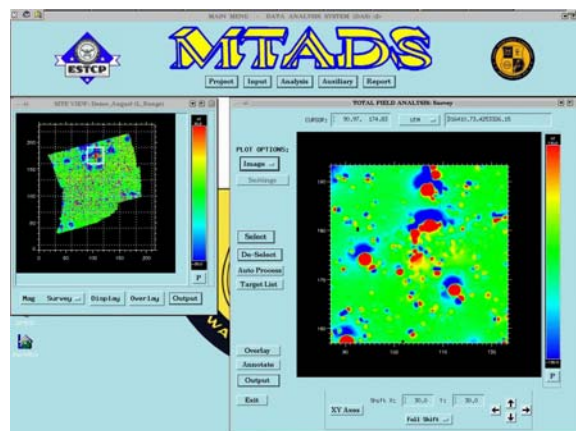


Figure 5 – Working screen of the MTADS DAS showing the project view on the left and an expanded analysis view on the right

In the case of isolated ordnance targets in the far field (i.e. farther from the sensors than their characteristic dimension) the DAS employs resident physics-based models to determine target size, position, and depth. Extensive data sets have been acquired and processed to calibrate these models. Using these models, we have demonstrated probabilities of detection of 95 to 97% and location accuracies of 15 cm with the magnetometer system.

Although we have achieved impressive results using the DAS, it has proven difficult to transition to the general UXO user community. Beginning with the demonstrations of the airborne system, we have performed the data preprocessing functions through generation of mapped data files using a commercial software package, Geosoft Oasis montaj™. An example of a working screen from montaj™ is shown in Figure 6. The upper panel of the screen shows a portion of the Oasis database, the middle shows corrected and uncorrected plots of one of the sensor tracks and the lower panel shows a detail of the interpolated sensor data.

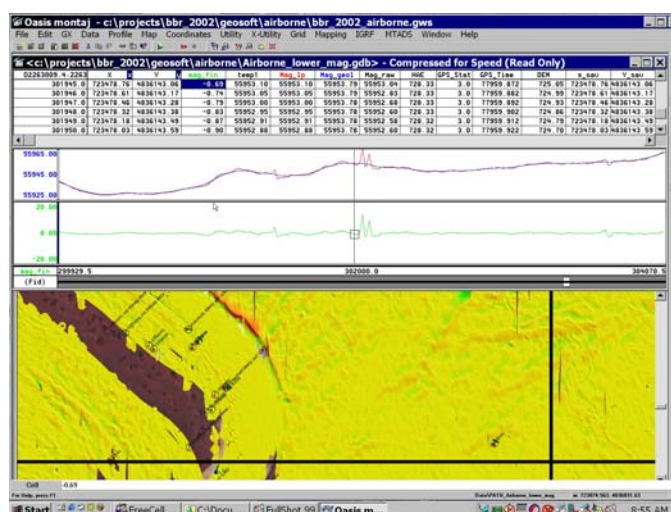


Figure 6 – A working screen of Oasis montaj™ showing airborne data

At this point in our development, we import the mapped data files generated using montaj™ into the DAS for target selection and analysis. We are in the process of converting the analysis routines developed under ESTCP and SERDP sponsorship to Geosoft GXs, executable files that can be called from the Oasis environment. This will allow us to perform the entire data analysis from input of raw data files through data quality checks, mapping of individual sensor readings, target selection, model fit, and finally generation of target lists and output graphics in the Oasis environment. All target analyses reported here were accomplished using routines in the MTADS DAS.

## 2.2 Previous Testing of the Technology

As mentioned above, the vehicular MTADS, which will serve as the comparison benchmark for this Demonstration, has been tested at a wide variety of sites over the past six years.<sup>2-12</sup> Of particular relevance is the demonstrated ability of the vehicular system to locate ordnance of the type to be encountered here with a mean location error of 12 cm and a 95% location distance of

29 cm.<sup>5</sup> Thus, the vehicular MTADS magnetometer system is ideal as a performance benchmark.

The airborne *MTADS* adjunct has been demonstrated three times at two sites over the past year and a half. The first full-scale demonstration was at the Badlands Bombing Range on the Pine Ridge Reservation in South Dakota in September 2001. During this demonstration a 10-acre site seeded with 25 inert projectiles (105-mm, 155-mm, and 8-inch) was flown to allow comparison of the system performance with that of the vehicular MTADS, which surveyed the same site. An additional 1600 acres were surveyed using the airborne system as part of continued clean-up efforts over the entire Impact Area. Analysis of the airborne data collected over the seeded site resulted in a total of 161 targets selected for digging including all of the seeded projectiles and one live, HE filled, 155-mm projectile.<sup>15</sup> The false alarm ratio for this site was  $161/26=6.2$ . A total of 1,193 targets were analyzed from the 1600 acre survey, resulting in 528 excavations and recovery of a total of 19 live UXO projectiles including eleven 155-mm and eight 8-inch projectiles.<sup>15</sup>

The second Demonstration of the airborne system was at Aberdeen Proving Ground in late July 2002. This demonstration involved an airborne survey of a total of 550 acres over selected sites, including a 94-acre calibration area and 770 additional acres over areas with varying terrain types, and UXO/clutter contamination levels. At this time, results are only available from the Phillips Air Field area, which was a seeded area containing 105-mm projectiles and 60- and 81-mm mortars. Even though the mortars are near, or below, the reliable detection threshold for the airborne system depending on geologic and system noise levels, the airborne MTADS achieved an overall  $P_d$  of 0.85 which comprised 1.0 for the 105-mm projectiles, and 0.67 for each of the mortar sizes. Further reporting awaits the results of a series of excavations planned on targets reported by the NRL and Oak Ridge systems.

The most recent Demonstration of the airborne MTADS was again at the Badlands Bombing Range in September 2002. This demonstration was a combined vehicular, man-portable, and airborne survey of the remaining area of the Impact Area not covered in the 2001 survey. The survey data collected in this demonstration have been analyzed and reported to the Demonstration sponsor, AFCEE. Remediation funding is not available at this time for the targets analyzed in the Demonstration.

### **2.3 Factors Influencing Cost and Performance**

The largest single factor affecting the airborne MTADS survey costs and production rates is the cost of operating the survey helicopter on site. During recent surveys, we have paid approximately \$700 per hour with a four hour daily minimum. Mobilization of the aircraft to and from the site from its home base is charged at these same rates. Therefore, to maximize production at minimum cost, surveys must be arranged with long survey lines to minimize the time spent in turns, frequent examinations of data quality to minimize time spent taking unacceptable data, minimal time lost to aircraft refueling by having fuel available on site, and aircraft basing to minimize daily ferry to and from the survey site.



## 2.4 Advantages and Limitations of the Technology

Unlike the vehicular magnetometer system, the airborne system is not capable of detecting the smallest classes of buried UXO at depth. However, we have taken data from Target N9 on the Laguna Pueblo, which has over 15,000 M 38 practice bombs, resampled the data and modeled the magnetic response that would be observed by an airborne sensor array above the ground. While the magnetic signals are spatially spread and diminished in intensity as the sensors move further above the ground, our results indicate that, at an altitude of 2 meters above the ground, the system should be capable of detecting BDU-33s or Mk 82s in all geologies and ordnance targets equivalent to or larger than 2.75-in warheads in geologically quiet areas.

In practice, the absolute limit of detection is limited by the background noise level, which is a combination of the geophysical noise and the platform-induced noise from the helicopter. The treatment of magnetometry data to correct for airborne platform-induced signals uses a standard technique called aeromagnetic compensation. This technique uses commercially-available equipment and reduces the platform-induced magnetic noise for fixed wing aircraft to on the order of 0.01 nT. This approach has been widely used in the geophysical exploration community on both fixed wing aircraft and for helicopters. Depending on the techniques used, and the type of platform, the compensation can reduce the platform and heading noise to 0.1-0.5 nT. This is well below the typical geophysical noise due to magnetic soils and rocks. The signal intensity from an individual ordnance item the size of a GP bomb (or an individual cache of ordnance) is a few tens to several hundred nT, even at several meters altitude. The ability to detect and characterize an isolated large target is therefore not a matter of signal strength or signal-to-noise ratio, but a matter of having a data sampling density high enough to identify the target as a target and to characterize its magnetic anomaly signature using dipole-fitting routines. These issues were incorporated into the design of the horizontal array spacing and the flying speed.

On large open ranges the vehicular MTADS provides an efficient survey technology. Surveys with the magnetometer array often exceed production rates of 20 acres per day. When a site has vegetation cover or topography that precludes vehicular traffic, the man-portable adjunct MTADS can often be used. However, there are sites that cannot be traversed on foot, others that are dangerous, and still others that contain isolated bombing targets or impact ranges, located at best imprecisely, within tens or hundreds of thousands of acres. For these sites, the Airborne MTADS will produce much more rapid and efficient surveying, with the commensurate economic benefits. The Airborne MTADS is capable of survey production rates of 50 acres/hour.

The helicopter is typically flown at a low altitude (1.5 - 5 meters), with an array horizontal sensor spacing of 1.5 meters, and the forward velocity of 20 meters per second. To achieve this, the sensors have been fixed to hard points on the helicopter. As seen in Figure 1, the sensor boom extends well in front of and is clearly visible to the pilot; this is (important for low altitude flights). With the sensor spacing of 1.5 meters, a data collection rate of 100 Hz, and a speed over ground of 20 m/sec, the data density provides 50 data points on a typical target to fit the dipole signature. Any yaw in the helicopter attitude during surveying decreases the effective sensor spacing, requiring adjacent survey lines to be flown closer together.



### **3. Demonstration Design**

#### **3.1 Performance Objectives**

This Demonstration consists of three overlapping surveys. First, a vehicular magnetometry survey of 100 acres near the previously-identified bull's eye, S1, on the Isleta Pueblo near Albuquerque, NM. Targets on this area are expected to be M-38 and BDU-33 practice bombs and an array of ordnance to be emplaced by the Army Engineering R&D Center at the direction of the ESTCP Program Office. Second, an airborne magnetometry survey of 1500 acres around the target to include the vehicular area. Finally, an airborne survey by Oak Ridge National Lab of the same 1500 acres.

The vehicular results will be used as a comparison benchmark for the results of the two airborne systems. Consequently, all the targets within the vehicular survey will be analyzed and fit. In the event that there are more than 2000 targets identified in the area, a subset agreed to by the ESTCP Program Office, the Institute for Defense Analyses (IDA), and NRL will be analyzed completely. Each of the airborne survey teams will independently analyze their data using the same parameters as the vehicular system. All three analyses will be submitted to ESTCP and IDA at the conclusion of the surveys as an Excel (\*.xls) file.

From these analyses, an inclusive dig list will be prepared by IDA as a text or Excel file and submitted to NRL and the dig teams. Each target will be excavated, precisely located using GPS, documented, and photographed. OE scrap will be collected for later certification and disposal. Any recovered live ordnance will be handled at the discretion of the UXO supervisor on site. All excavations will be filled, tamped, and returned to grade.

The specific objective of this Demonstration is to produce a quantitative comparison among the airborne systems. This comparison will include probability of detection and false alarm rate. These quantities will be calculated as a function of threshold parameter where possible so that an ROC-type analysis can be performed.

#### **3.2 Selecting the Test Site**

The location for this Demonstration was chosen by the ESTCP Project Office in conjunction with the Environment Department of the Pueblo of Isleta. Subsequent to the choice of sites, representatives of the NRL and Oak Ridge teams met at the site with Mr. Jim Piatt, the Director of the Environment Department, walked several of the possible targets, and settled on Target S1 for this survey. This target was chosen because it is of most concern to the tribe, it has the greatest possibility of containing HE-filled UXO since the tribe has located some heavy-wall fragments on the site, and it offers the opportunity to survey the largest area within the available resources.

#### **3.3 Test Site History/Characteristics**

“The Pueblo of Isleta is located in north-central New Mexico, approximately 10 miles south of Albuquerque. The Reservation is bordered on the north by the Sandia Military Reservation, which includes Kirtland Air Force Base, the Manzano Mountains on the east, and the Rio Puerco

and Laguna Pueblo Reservation on the west.”<sup>16</sup> The area referred to as Site B in the Draft Site Assessment Report,<sup>16</sup> which contains target S1, comprises an area of approximately 7000 acres that were leased from the Tribe in the 1950’s for use as a target bombing range for aircraft from Kirtland. Documentation in Bureau of Indian Affairs files indicate that this area was used as a practice bombing range from 1956 to 1961 to determine the performance of fast aircraft during bombing runs. In the 1960’s, Kirtland collected and piled visible ordnance debris for removal. Up to 2 tons of practice bombs and ordnance waste per acre were removed but no explosive ordnance was found.

### 3.3.1 Climate and Weather

During the month of February, the normal high temperature in Albuquerque is 53 °F with a normal low of 26 F. The average temperature is 41 °F. Of more importance for survey work, February is the second driest month historically with normal precipitation of just under 0.5 inches. In February 2002, the mean wind was less than 2 mph from the SW.

### 3.3.2 Topography

The site consists of open, semi-arid terrain. The area is relatively flat, open grassland with elevation increasing from 5100 feet above sea level on the west to a maximum of 5400 feet above sea level and a broken escarpment on the east.

### 3.3.3 Site Maps and Photographs

Figure 7 is a portion of a USGS 7.5-minute topo map showing the location of Target S1 with the approximate boundaries of the proposed surveys outlined. The most direct access to the site is by a dirt road that exits to the north from New Mexico Highway 6, 14 miles west of Exit 203 off Interstate 25. This dirt road is maintained by Isleta Pueblo personnel. An NRL contractor, Geometrics GPS, Inc. of Fredericksburg, VA, has established two geodetic survey points near Target S1 and four more on various other targets on the Pueblo’s Comanche Ranch. The approximate positions of the two first-order points near S1 are indicated in Figure 7. The coordinates of all six points are given in Table 1. An example of the predominant M38s and one of the few heavy-walled fragments is shown in Figure 8.

Table 1. Isleta Survey Coordinates Installed for this Demonstration.

| Point | Latitude            | Longitude            | Northing (m)  | Easting (m) | Ellipsoid Height (m) |
|-------|---------------------|----------------------|---------------|-------------|----------------------|
|       |                     |                      | NAD 83        |             |                      |
| 1A    | 34° 50' 09.53499" N | 106° 59' 12.69597" W | 3,856,654.157 | 318,321.948 | 1528.443             |
| 1B    | 34° 51' 12.19331" N | 106° 59' 18.29422" W | 3,858,587.492 | 318,218.027 | 1541.863             |
| 2     | 34° 41' 21.33042" N | 106° 54' 36.41382" W | 3,840,244.133 | 325,030.974 | 1486.639             |
| 3     | 34° 33' 12.69605" N | 106° 56' 50.72926" W | 3,825,255.338 | 321,322.056 | 1535.667             |
| 7     | 34° 31' 20.82374" N | 107° 03' 41.28845" W | 3,822,016.365 | 310,786.481 | 1616.955             |
| 8     | 34° 40' 03.72964" N | 107° 05' 21.49078" W | 3,838,179.459 | 308,565.015 | 1702.621             |

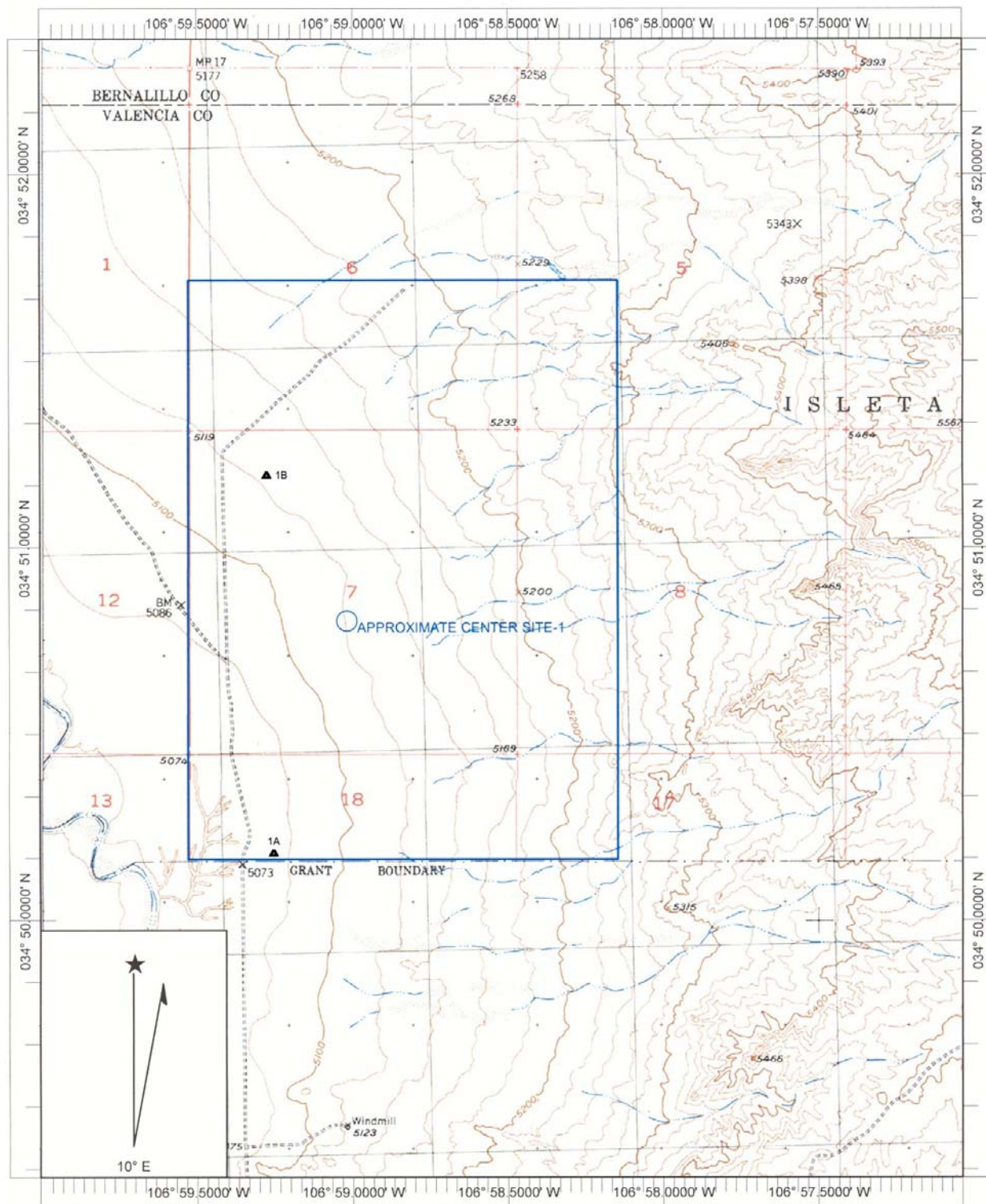


Figure 7 – A portion of a USGS topo map showing the approximate boundaries of the survey area around the target position. The location of the two first-order points installed for this survey are shown as triangles.



Figure 8 – Photograph of the M38 practice bombs (left panel) and one of the few heavy-walled fragments (right panel) found on the site

### 3.4 Testing and Evaluation Plan

#### 3.4.1 Pre-Demonstration Activities

The MTADS vehicular system as well as components of the airborne system will be mobilized to the Isleta Pueblo S-1 site in a rented 53-ft trailer. The tow vehicle, the magnetometer trailer, notebook computers for the DAS and Oasis montaj™, an office PC, GPS equipment, batteries and chargers, office equipment, radios and chargers, tools, equipment spares, and maintenance items, and the airborne boom components and magnetometers will be transported in the trailer. A government contract transportation firm will transport the trailer to the site. The helicopter will be mobilized to the site by the helicopter charter firm, Helicopter Transport Services.

Due to the remoteness of the survey site, no essential support services are available on-site. Accordingly, NRL has made provisions to acquire all of the requisite supplies, materials, and facilities from rental firms in Albuquerque. For this operation one trailer will be used exclusively for data processing and analysis, as a communications center, battery storage and charging stations, an electronics repair station, and storage for spares and supplies. This trailer will have AC power and heat. A second 8 x 48 foot trailer, which can be fully opened from either end (for drive through), will be used to garage and for secure storage of the MTADS vehicle and sensor platform. Power to the trailers will be provided by a 65 KW diesel field generator that will also be used to recharge the vehicle, radios and GPS batteries overnight. Communications among on-site personnel will be provided by hand-held VHF radios, with a base station located in the command trailer. Radios will be provided to all field and office teams. Cellular phone communications will be available at the office trailer. Fuel storage will be provided for the ac generator and portable toilets will be provided to support all field and office crews with weekly servicing. Figure 9 shows the arrangement of this logistics support at a recent survey.

The area around Target S1 will be divided into two survey sites. A larger, 1500-acre site, will be covered completely by both airborne systems. Within this site, a second, 100-acre site will contain the seed ordnance and also be surveyed by the vehicular system. The coordinates for the both areas are given in Table 2.



Figure 9 – Aerial photo of a recent MTADS field base camp showing the relative locations of the logistics support trailers, etc.

Table 2. Coordinates for the Corners of the Two Surveys.

| Point   | Latitude         | Longitude         | Northing (m) | Easting (m) |
|---------|------------------|-------------------|--------------|-------------|
|         |                  |                   | NAD 83       |             |
| Air-NW  | 34° 51' 42.726"N | 106° 59' 31.494"W | 3,859,534.87 | 317,901.48  |
| Air-NE  | 34° 51' 42.972"N | 106° 58' 08.556"W | 3,859,500.82 | 320,007.88  |
| Air-SE  | 34° 50' 09.696"N | 106° 58' 08.724"W | 3,856,627.06 | 319,947.15  |
| Air-SW  | 34° 50' 09.576"N | 106° 59' 31.632"W | 3,856,664.97 | 317,840.93  |
| Vhcl-NW | 34° 51' 18.912"N | 106° 59' 05.400"W | 3,858,788.00 | 318,549.62  |
| Vhcl-NE | 34° 51' 19.038"N | 106° 58' 55.650"W | 3,858,786.99 | 318,797.32  |
| Vhcl-SE | 34° 50' 26.694"N | 106° 58' 56.400"W | 3,857,174.63 | 318,746.38  |
| Vhcl-SW | 34° 50' 26.940"N | 106° 59' 06.294"W | 3,857,187.19 | 318,495.20  |

### 3.4.2 Period of Operation

A tentative schedule for the major items in the Demonstration is given in tabular form in Table 3. All times associated with survey and remediation activities are planned times only and will be adjusted on-site to accommodate the vagaries of the weather and other natural conditions.

Table 3. Isleta Survey Demonstration Planning Schedule

| Date                          | Planned Action   |
|-------------------------------|--|
| Tues, January 7 <sup>th</sup> | First-order points installed, final definition of 1500-acre site |
| Week of Jan 27 <sup>th</sup>  | Pick up and pack trailer   |
| Week of Feb 3 <sup>rd</sup>   | Trailer leaves Blossom Point for Isleta Pueblo                   |



| <b>Date</b>                  | <b>Planned Action</b>  |
|------------------------------|--|
| Thurs, Feb 13 <sup>th</sup>  | Trailer arrives Isleta, Environmental Office personnel meet and locate Logistics items arrive at the survey site                         |
| Mon, Feb 17 <sup>th</sup>    | MTADS personnel arrive Albuquerque; unpack trailer, transport airborne components to ABQ, begin assembly of airborne system              |
| Tues, Feb 18 <sup>th</sup>   | Helicopter arrives at ABQ; begin outfitting helicopter   |
| Wed, Feb 19 <sup>th</sup>    | Begin airborne surveys   |
| Thurs, Feb 20 <sup>th</sup>  | VIP Visit day<br>Begin analysis of airborne data from the 100-acre site in Washington  |
| Sat, Feb 22 <sup>nd</sup>    | Complete airborne surveys  |
| Sun, Feb 23 <sup>rd</sup>    | Disassemble airborne system; helicopter departs<br>Personnel for vehicular survey arrive Albuquerque                                     |
| Mon, Feb 24 <sup>th</sup>    | Transmit airborne results from 100-acre site to IDA<br>Begin vehicular survey<br>Begin analysis of remaining airborne data in Washington |
| Fri, Feb 28 <sup>th</sup>    | Complete vehicular survey  |
| Sat, Mar 1 <sup>st</sup>     | Pack trailer   |
| Sun, Mar 2 <sup>nd</sup>     | MTADS personnel depart   |
| Week of Mar 3 <sup>rd</sup>  | Complete vehicular data analysis in Raleigh  |
| Week of Mar 3 <sup>rd</sup>  | Trailer departs Isleta   |
| Fri, Mar 7 <sup>th</sup>     | All analyses submitted to IDA  |
| Week of Mar 10 <sup>th</sup> | Trailer arrives at Blossom Point; unpack   |
| Fri, Mar 14 <sup>th</sup>    | IDA dig list to NRL  |
| Mon, Mar 17 <sup>th</sup>    | Begin remediation  |
| Week of Mar 17 <sup>th</sup> | Return trailer   |

### **3.4.3 Target Remediation**

After IDA personnel develop a joint prioritized dig list, remediation will begin. The remediation contractor, EOTI of Rumsen, NJ, is working with a fixed budget that will allow approximately 700 – 800 targets to be dug. Details of the remediation plan can be found in Appendix A. NRL personnel will be on-site for the first few days of the remediation effort to train the EOD personnel in operation of the GPS target relocation equipment and to provide QC. Each week, details of the week's remediation effort will be express delivered to NRL for transmittal to IDA.

## 4. Performance Assessment

### 4.1 Performance Criteria

Table 4. Performance Criteria for this Demonstration

| Performance Criterion                    | Description  | Primary or Secondary |
|--|--|----------------------|
| Hazardous Materials                      | This Demonstration is primarily concerned with M38 and BDU-33 practice bombs. No HE-filled ordnance has been found on this site. ESTCP plans to seed a small number of inert ordnance items on the site.   | Primary              |
| Factors Affecting Technology Performance | The three main factors affecting the success of this technology are $P_D$ , location accuracy, and production rate. In two recent Demonstrations of the airborne MTADS at the Badlands Bombing Range and Aberdeen Proving Ground we have achieved good $P_D$ and location accuracy for a different mix of targets so we expect success here. Our system design and field procedures are oriented toward high coverage rates and, thus, low per acre costs.   | Primary              |
| Ease of Use                              | A minimum of four people is required to conduct an airborne MTADS survey with an additional analyst in the field, or at home, to complete target analysis. They include a site/project supervisor, a pilot, a data acquisition operator, and a data preprocessor. While the position of project supervisor and data acquisition operator do not strictly require advanced training, we have found that the decision and diagnostic skills of more highly-trained scientists and engineers result in project efficiencies that more than compensate for the added personnel cost. At the present stage of development, the data preprocessor and analyst must be experts. As we gain more experience with the methods and refine the default assumptions we expect this requirement to relax. | Secondary            |
| Maintenance                              | The maintenance required for MTADS is typical of that required by computers and peripherals, laboratory and field electronics, and for transportation vehicles. We do not anticipate any specialized requirements. Maintenance Manuals and preventive maintenance procedures have been established for all MTADS subsystems. Electronic and mechanical repair equipment and tool sets are packaged for transport to all demonstration sites. A list of critical spare components is maintained, as are materials for anticipated maintenance and repairs (vehicle service, cable repairs, computer change-out, etc).   | Secondary            |

## **4.2 Performance Confirmation Methods**

Evaluation of performance is straightforward in this Demonstration. The two primary metrics are probability of detection ( $P_D$ ) for the seeded and any pre-existing UXO and the number of false alarms required to be dug to achieve this  $P_D$ . All analysis methods to be used involve classifying targets into one of six UXO categories. This will allow an ROC-like analysis to be performed. The baseline for all comparisons will be the standard MTADS magnetometer analysis conducted on the vehicular data by an experienced, skilled analyst. Success or failure for each of the airborne systems will be judged simply by their respective performance compared to this baseline.

## **4.3 Data Analysis, Interpretation and Evaluation**

Each of the MTADS data sets (vehicular and airborne) will be collected and analyzed by a separate crew. The survey data will be analyzed using the proven MTADS magnetometer analysis routines. Following our standard practice which was introduced at the JPG V Demonstration, the targets will be classified using a six-bin scheme where category one corresponds to high confidence ordnance, category two is medium confidence ordnance, category three is low confidence ordnance, category four is low confidence clutter, category five is medium confidence clutter, and category six is high confidence clutter. A spreadsheet containing details of the target location and fit parameters along with this classification will be provided. In addition, a list of all anomalies above background will be provided.

A separate dig list will be prepared for each analysis method and electronically transmitted to the Institute for Defense Analyses. Following completion of all analyses, a master dig list will be prepared by IDA and given to NRL for transmission to the remediation teams. Each target will be uncovered, located, classified, documented, photographed, and disposed of as appropriate. After all targets have been investigated, a master target list will be prepared that will include target number, orientation, depth, classification, etc. This report will also be transmitted to IDA.

Evaluation of the results of the Demonstration will be a simple matter of comparing the predictions of each method against remediation results. The first level of analyses will be the construction of an ROC-like curve for each method. If warranted by the results, further evaluations can be performed for individual target classes, depths, etc.

## **5. Cost Assessment**

Mobilization, logistics, survey and analysis, target recovery, scrap disposal and reporting costs will be separately accounted and tabulated in the Demonstration Report. A Cost and Performance analysis will be carried out and reported as an ESTCP Cost and Performance Report covering this Demonstration.



## **6. Implementation Issues**

All operations associated with this demonstration have been coordinated with and the Demonstration Plan in Draft form has been submitted for comment to the ESTCP Program Office and the Environment Department of the Pueblo of Isleta through the Director, Jim Piatt.

NRL, Code 6110, is the program manager for all activities associated with the vehicular and airborne MTADS Demonstration at Isleta. The NRL on-site project manager, H. H. Nelson, or his designated assistant, is responsible for coordinating operations on the target area and approving alterations or changes to the demonstration plan or schedule. All persons working on site are NRL employees, contractors working for NRL, or are employees or subcontractors of the prime contractors identified in Section 8 of this Demonstration Plan. As defined in the Site Safety Plan, there will always be a Safety Officer on site who is the authority for decisions on safety-related issues. The Senior UXO Specialist is the safety officer in charge of UXO digging operations. On each day that surveying or digging operations are conducted tailgate site safety briefings will be conducted before field work begins. Separate safety briefings may be conducted for UXO and the survey crews.

The airborne survey crew will consist of H. H. Nelson (NRL), David Wright (AETC), and Nagi Khadr(AETC) on site and J. R. McDonald(AETC) in Washington. David Wright will collect the data as the helicopter data acquisition specialist, Nagi Khadr will handle data quality checks and pre-processing, J. R. McDonald will conduct all target analyses. H.H. Nelson will participate in nightly data quality assessments at an oversight level only and will have no role in the data analyses. The vehicular crew will consist of H. H. Nelson (NRL), Glenn Harbaugh (Nova), Dan Steinhurst (Nova), and Tom Furuya(AETC) on site. Glenn Harbaugh and Dan Steinhurst will be in charge of data acquisition and Dan Steinhurst and Tom Furuya will handle the data quality checks and preprocessing. Tom Furuya will perform the data analyses in Raleigh, NC the following week. As for the airborne system, H.H. Nelson will participate in nightly data quality assessments at an oversight level only and will have no role in the data analyses.

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## 8. Points of Contact

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|                |                     |  |
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**Pueblo of Isleta**

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|-----------|----------------------------------|---|
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**EOTI, Inc**

|                |                       |  |
|----------------|-----------------------|--|
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**Hotel Accomodations**

|                 |   |  |
|-----------------|---|--|
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|-----------------|---|--|

## **Appendix A. Validation Plan**

After preparation of the master dig list by IDA personnel, it will be transmitted to the remediation team by NRL. An NRL representative will be on-site for the first few days of remediation to train the EOD crew in the procedures to be followed and equipment to be used and to serve a QC function.

Each target on the dig list will be relocated using a backpack RTK GPS system and a flag placed at its location. It has been our experience that aiming to place the flag within 10 cm of the actual target location is a good compromise between relocation accuracy and flagging efficiency. If there are livestock actively grazing the site, only one day's flags can be placed in the field, if not, the flag crew can stay a day or two ahead of the remediators.

Each target to be remediated will have an associated dig sheet for the field crew, Figure 10. This dig sheet lists the target depth and approximate size and contains any comments the analyst desires to transmit to the dig crew. These comments often involve direction such as "ignore the fin in the NW corner of the target and dig the bomb at 5 feet." After the dig crew uncovers the target, they fill out the dig sheet with target details and observations, photograph the target and mark it for reacquisition by the GPS crew. This reacquisition of the actual target location establishes electronically the systems location accuracy.

Following reacquisition, the target will be disposed of as appropriate. If the EOD team deems the target to be hazardous, they can transport it to a staging point or mark it to be blown in place at their discretion. All decisions regarding safe disposition of targets will be made by the Senior UXO Supervisor in the field.

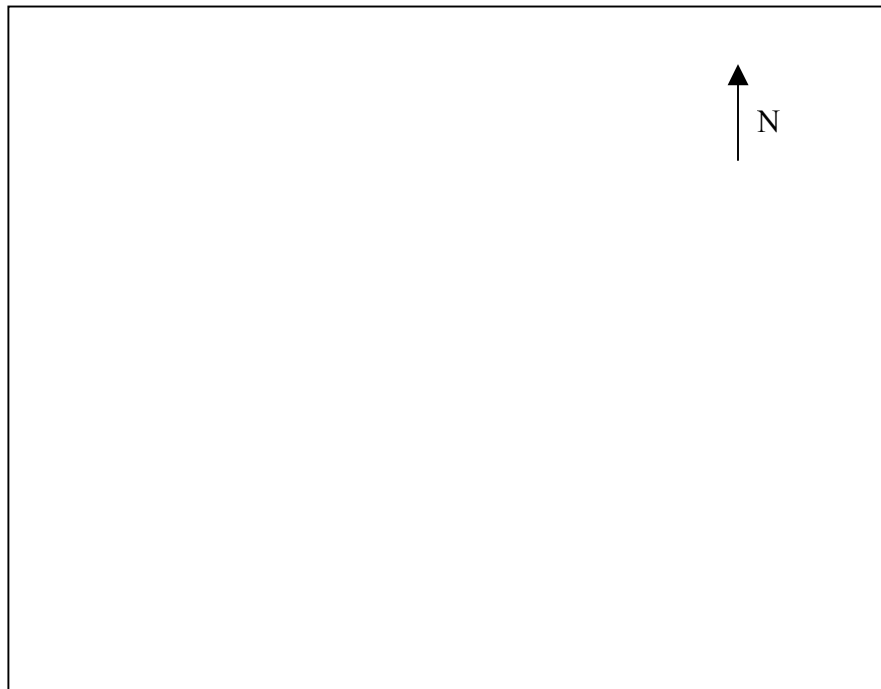
Pueblo of Isleta

# DIG SHEET

MTADS

|           | Target Num.          | Lat <sub>cm</sub> | Lon <sub>cm</sub> | Dia. (in) | Depth <sub>cm</sub> (ft) | Depth <sub>nose</sub> | Depth <sub>base</sub> | Azimuth |
|-----------|----------------------|-------------------|-------------------|-----------|--------------------------|-----------------------|-----------------------|---------|
| Predicted | V132                 | Predicted Lat     | Predicted Lon     | 6         | 4.7«                     |                       |                       | T       |
| Actual    |                      |                   |                   |           |                          |                       |                       | M       |
| Comment   | Analyst Comment here |                   |                   |           |                          |                       |                       |         |

Field Drawing



Field Comment:

---



---



---



---



---

Field ID:

---

☐ Fuzed

☐ Unfuzed

☐ Live

☐ Inert

☐ Ordnance

☐ Ordnance Related

☐ Non-ordnance

Estimated Weight: \_\_\_\_\_

Photograph Number: \_\_\_\_\_

Site: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_ UXO Supervisor: \_\_\_\_\_

## **Appendix B. NRL SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN**





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# NRL SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

## 1. INTRODUCTION

The Naval Research Laboratory (NRL) has been tasked to conduct a Geophysical Survey of selected areas of Target S1, within the boundaries of the Isleta Pueblo, approximately 15 miles south of Albuquerque, NM. This Safety, Health, and Emergency Response Plan (SHERP) describes the general methodology to be used on site, establishes the minimum standards, and defines the operating parameters to be used on this site to ensure personnel safety at all times.

Site access and entry control is the responsibility of the Project Manager working in conjunction with the Site Safety Officer and the Senior UXO Supervisor. It is NRL's intent to limit movements and activities of people and equipment at the project site to those necessary to accomplish the goals established in the Demonstration Plan. Site access control is based on site-specific characteristics including:

- a. Potential operational hazards;
- b. Hazards associated with the terrain;
- c. Expected weather conditions; and
- d. Planned site activities (including all UXO Activities)

Site access control will include the following provisions:

- a. Controlled site ingress/egress points;
- b. Required worker/visitor registration;
- c. Establishing security barriers and/or flagging;
- d. Escorting of visitors not included in the work parties or demonstration plan; and
- e. Posting of site/work area boundaries as required.

## **2. POTENTIAL HAZARDS OF CONCERN**

The potential hazards of concern at the survey site include possible UXOs. The potential UXO hazards of concern are specifically addressed in the Demonstration Plan, Sections 4.1.2 and 4.1.3, the section of this document titled “Safety Precautions for UXOs,” and “Safety Concepts and Basic Considerations for UXO Operations.”

### **2.1 Recommended Protective Measures**

Intrusive activities will be performed using OSHA Level D Personnel Protective Equipment (PPE) (i.e. a work uniform affording minimal protection, used for nuisance contamination only). Geophysical survey personnel will not be involved with any excavations on this site. Way pointing personnel and UXO personnel will perform or be present for any excavations. Surface debris presents a very low risk of exposure because several site walkovers have previously been conducted by the Air Force EOD from Kirtland Air Force Base.

### **2.2 Physical Hazards**

The physical hazards of this work include hazards associated with field construction work, such as heat and cold stress, heavy equipment operations, and manual lifting of heavy objects. Additional information concerning environmental hazards is contained in the section of this document titled Environmental Precautions.

### **2.3 Plant/Animal/Biological Hazards**

The biological hazards most likely to be encountered by site personnel include animal bites, insect stings, or contact with irritant plants. These hazards are applicable to all activities.

#### **2.3.1 Animal and Insect Bites**

Animal bites or stings are usually nuisances (characterized by localized swelling, itching, and minor pain) which can be handled by basic first-aid treatment. The bites of certain snakes, and spiders contain sufficient poison to warrant medical attention. There are diseases that can be transmitted by insect and animals bites (mainly dogs, skunks, and foxes) e.g., Rocky Mountain spotted fever, Lyme disease (tick); rabies; malaria; and equine encephalitis (mosquitoes). The greatest hazard and most common cause of fatalities from animal bites and insect stings, particularly bees, wasps, and spiders, is from a sensitivity reaction. In these sensitized individuals shocks due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems, which also can result in death. None of the personnel expected to be working on this task are known to be allergic to insect stings. If anyone is assigned subsequently who is allergic, they are required to have their prescribed treatment with them, and to inform first aid personnel where it is located. All stings or bites will be taken seriously. Anyone stung or bitten will be required to stop work while that person is observed for signs of severe swelling, shortness of breath, nausea, or shock. If there is any doubt, medical attention will be obtained.

Fieldwork increases the likelihood of coming in contact or exposure to fleas and ticks. Workers are to observe the following precautions:

- a. Apply insect repellents to boots and other garments, particularly pant legs, during spring and summer seasons.
- b. Perform self examination for ticks every 4 hours while on-site during spring and summer seasons.
- c. Avoid all wild animals, especially wild animals that are overly passive or aggressive. Report such animals to appropriate base environmental/health personnel.
- d. Skunks, raccoons, and foxes are the wild animals most frequently found to be infected with rabies. However, any warm-blooded animal could be infected. If bitten by an animal suspected of being infected with rabies, try to capture the animal without being bitten again, or contacting the mouth or any saliva, or keep the animal under surveillance, and call the appropriate base agency for assistance in capturing the animal.
- e. Have the animal tested. A dead animal suspected of being infected should be preserved and tested also. Health departments are often sources of testing or obtaining information about where testing can be done.
- f. As quickly as possible, wash the bite area with soap and water and disinfect with 70% alcohol, then go to a doctor or an emergency room for follow-up treatment.
- g. Rabies is preventable, even after being bitten, if treatment is begun soon enough. Thus, getting prompt medical attention, confirming that you may have been exposed to rabies, and immediate initiation of treatment is critical.
- h. Rabies is **NOT CURABLE** once symptoms or signs of rabies appear.

### ***Snakes***

When site activities are conducted in warm weather on sites located in wooded, grassy or rocky environments the potential for contact with poisonous snakes becomes a real danger. Normally, if a person is approaching a snake, the noise created by the person is usually sufficient to frighten the snake away. However, during the warm months, extreme caution must be exercised when conducting site operations around areas where snakes might be found. The rules to follow for snake bites are:

- a. DO NOT cut Xs over the bite area, as this will intensify the effect of the venom.
- b. DO NOT apply suction to the wound since this has minimal effective in removing venom.
- c. DO NOT apply a tourniquet since this will concentrate the venom and increase the amount of tissue damage in the immediate area.



- d. If possible, kill the snake, bag it and transport it with the victim or try to get a good look at it so it can be identified for proper selection of antivenom.
- e. DO NOT allow the victim to run for help since running increases the heart rate and will increase the spread of the venom throughout the body.
- f. Keep the victim calm and immobile.
- g. Have the victim hold the affected extremity lower than the body while waiting for medical assistance.
- h. Transport the victim to medical attention **IMMEDIATELY**.

### *Spiders*

A large variety of spiders may be encountered during site activities. While most spider bites merely cause localized pain, swelling, reddening and in some cases, tissue damage, there are a few spiders which, due to the severity of the physiological affects caused by their venom, are dangerous. The two poisonous spiders for this area are the Black Widow and the Brown Recluse. There is no effective first aid treatment for either of these bites. Except for very young, very old or weak persons, these spider bites are not considered life threatening; however, medical treatment must be sought to reduce the extent of damage caused by the injected toxins. If either of these spiders are suspected or known to be on site, the Site Safety Officer will brief site personnel as to the identification and avoidance of the spiders. As with stinging insects, site personnel shall report to the Project Manager/Senior UXO Supervisor if they locate either of these spiders on site or notice any type of bite while involved in site activities. These species include the black widow and the brown or violin spiders.

The black widow is a coal-black bulbous spider 3/4 to 1 1/2 inches in length, with a bright red hourglass marking on the underside of its abdomen. The black widow is usually found in dark moist locations, especially under rocks, logs, etc. Victims of a black widow bite may exhibit the following signs or symptoms:

- a. Sensation of pinprick or minor burning at the time of the bite.
- b. Appearance of small punctures (sometimes none is visible).
- c. After 15 to 60 minutes, intense pain is felt at the site of the bite which spreads quickly and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, poor coordination, dilated pupils and generalized swelling of face and extremities.

The brown recluse, or violin spider, is brownish to tan in color, rather flat, 1/2 to 5/8 inches long with a dark brown "violin" marking on the underside. There are three varieties of the brown spider, which present a problem to site personnel. These are the brown recluse, the desert violin and the Arizona violin. These spiders are found in variety of locations including trees, rocks or

in dark locations. Victims of a brown or violin spider bite may exhibit the following signs or symptoms:

- a. Blistering at the location of the bite, followed by local burning within 30 to 60 minutes after the bite.
- b. Formation of a large, red swollen, pustulating lesion with a bull's eye appearance.
- c. Systematic affects may include a generalized rash, joint pain, fever, nausea and vomiting.
- d. Pain may become severe after 8 hours, with the onset of tissue necrosis.

### ***Bees, Hornets, and Wasps***

Contact with stinging insects like bees, hornets and wasps may result in site personnel experiencing adverse health affects that range from mildly uncomfortable to life threatening. Therefore, stinging insects present a serious hazard to site personnel and extreme caution must be exercised whenever site and weather conditions increase the risk of encouraging stinging insects. Some of the factors that are related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- a. The nests for these insects are frequently found in remote wooded or grassy areas.
- b. The nests can be situated in trees, rocks, bushes or on/in the ground, and are usually difficult to see.
- c. If a worker accidentally disturbs a nest, the worker may be inflicted with multiple stings, causing extreme pain and swelling which can leave the worker incapacitated and in need of medical attention.
- d. Some people are hypersensitive to the toxins from a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock.
- e. Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the eyes, face, mouth and respiratory passages.
- f. The hypersensitivity needed to cause anaphylactic shock, can in some people, accumulate over time and exposure, therefore, even if someone has been stung previously, and has not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction if stung again.

With these things in mind, and with the high probability of contact with stinging insects, all site personnel will comply with the following safe work practices:

- a. If a worker knows that he is hypersensitive to bee, wasp or hornet stings, he must inform the Project Manager/Site Safety Officer or Senior UXO Supervisor of this condition prior to participation in site activities.
- b. All sites personal will be watchful for the presence of stinging insects and their nests, and will advise the Project Manager/Site Safety Officer or Senior UXO Supervisor if a stinging insect nest is located or suspected in the area.
- c. Any nests located on site will be flagged and personnel will be notified of its presence.
- d. If stung, site personnel will immediately report to the Site Safety Officer to obtain first aid treatment and to allow the Project Manager to observe them for signs of allergic reaction.
- e. Site personnel with a known hypersensitivity to stinging insects will keep required emergency medication on or near their person at all times.

### ***Ticks***

The Center for Disease Control has noted the increase of Lyme Disease and Rocky Mountain Spotted Fever caused by bites from infected ticks that live in and near wooded areas, tall grass, and brush. Ticks are small, ranging from the size of a comma up to about one quarter inch. They are sometimes difficult to see. The tick season extends from spring through summer. When embedded in the skin, they may look like a freckle.

Lyme disease has been confirmed in 43 states, with the heaviest concentrations in the Northeast (Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania), the upper Midwest (Minnesota and Wisconsin), and along the northern California coast. It is caused by deer ticks and the lone star tick. Female deer ticks are about one quarter inch in size, and are black or brick red in color. Male deer ticks are smaller, and completely black. Lone star ticks are larger and chestnut brown in color.

Rocky Mountain Spotted Fever has occurred in 36 states, with the heaviest concentrations in Oklahoma, North Carolina, South Carolina, and Virginia. It is caused by the Rocky Mountain woods tick, and dog ticks infected with rickettsia. Both are black in color.

The first symptoms of either disease are flu like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If immediately treated by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms may occur. If you believe you have been bitten by a tick, or if any of the signs and symptoms noted above appear, contact the Site Safety Officer/ Project Manager, or Senior UXO Supervisor/UXO Safety Officer.

Standard field gear (work boots, socks and light-colored coveralls) provide good protection against tick bites, particularly if the joints are taped. However, even when wearing field gear, the following precautions shall be taken when working in areas known to be infested with ticks:

- a. When in the field, check yourself often for ticks, particularly on your lower legs and areas covered with hair.
- b. Spray outer clothing, particularly your pant legs and socks, **BUT NOT YOUR SKIN**, with an insect repellent that contains permethrin or permethrin.
- c. When walking in wooded areas avoid contact with bushes, tall grass, or brush as much as possible.
- d. If you find a tick, remove it by pulling on it gently with tweezers.
- e. Be sure to remove all parts of the tick's body, and disinfect the area with alcohol or other antiseptic.
- f. For several days after removal of tick, look for signs of the onset of Lyme disease, such as a rash that looks like a bull's eye or an expanding red circle surrounding a light area, frequently seen with a small welt in the center.
- g. Also look for the signs of the onset of RMSF, such as an inflammation which is visible in the form of a rash comprising many red spots under the skin, which appears 3 to 10 days after the tick bite.

### **2.3.2 Hazardous Flora**

The most dangerous toxic effects from plants are due to the ingestion of nuts, fruits, or leaves. Consequently, personnel are prohibited from eating any fruits, nuts, or other plant material growing on the site. Incidence of contact by individuals to poisonous/thorny plants is a threat. Bare skin should be covered as much as practical when working in forested areas (i.e., long pants and shirt, boots, leather or cotton gloves, safety glasses, and head protection).

#### ***Plants Causing Skin and Tissue Injury***

Contact with splinters, thorns, and sharp leaf edges is of concern to site personnel, as is the contact with the pointed surfaces found on branches, limbs and small trunks left by site clearing and grubbing. This concern stems from the fact that punctures, cuts, and even minor scrapes caused by accidental contact may result in skin lesions, and the introduction of fungi or bacteria through the skin or eye. Personnel receiving any of the injuries listed above, shall report immediately to the Site Safety Officer/UXO Safety Officer for initial and continued observation and care of the injury.

#### ***Plants Causing Skin Reactions***

The poisonous plants of greatest concern are poison ivy, poison sumac, and poison oak. Poison ivy thrives in all types of light and usually grows in the form of a trailing vine, however, it also grows as a bush and can attain heights of 10 feet or more. Poison ivy has shiny, pointed leaves that grow in clusters of three. Poison sumac is tall scrub or slender tree that usually grows along

swampy areas or ponds, and in wooded areas. Each poison sumac leaf stalk has 7 to 13 leaflets, which have smooth edges. Poison oak is mostly found in the southeast and west. Poison oak resembles poison ivy, with one important difference, the poison oak leaves are more rounded rather than jagged like poison ivy, and the underside of poison oak leaves are covered with hair.

The skin reaction associated with contact of these plants is caused by the body's allergic reaction to toxins contained in oils produced by the plant. Becoming contaminated with the oils does not require contact with just the leaves. Contamination can be achieved through contact with other parts of the plant such as the branches, stems or berries, or contact with contaminated items such as tools and clothing. The allergic reaction with exposure to these plants will generally cause the following signs and symptoms:

- a. Blistering at the site of contact, usually occurring within 12 to 48 hours after contact.
- b. Reddening, swelling, itching and burning at the site of contact.
- c. Pain, if the reaction is severe.
- d. Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

If rash is scratched, secondary infections can occur. The rash usually disappears in 1 to 2 weeks in cases of mild exposure and up to 3 weeks when exposure is severe. Preventive measures that can prove effective for most site personnel are:

- a. Avoid contact with any poisonous plants on site, and keep a steady watch to identify, report and mark poisonous plants found on site.
- b. Wash hands, face or other exposed areas at the beginning of each break period and at the end of each workday.
- c. Avoid contact with, and wash on a daily basis, contaminated tools, equipment and clothing.
- d. Barrier creams detoxification/wash solutions and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- e. Keeping the skin covered as much as possible (i.e., long pants and long sleeved shirts) in areas where these plants are known to exist will limit much of the potential exposure.

### 3. WORK ZONES

During normal (*MTADS*) survey operations, the following designations are used for specified work areas:

- a. Immediate work area (the area being surveyed),
- b. Support area (vehicle parking, etc),
- c. Emergency assembly point (in the event of an accident), and
- d. Exclusion Zones during remediations and UXO work, access is limited to UXO Technicians.

The following work zones will apply during all UXO excavations and will be established prior to any target excavations. The Senior UXO Supervisor, prior to initiating operations to control site access, will establish work zones. Establishment of work zones will be based upon site conditions, activities, and exposure potentials. Whenever applicable, work zones will be clearly marked using placards or signs and enclosed using hazard tape, ropes, chains or fences. The Senior UXO Supervisor controls access to each work zone to ensure that all site workers and visitors have received the proper training and medical surveillance required entering a specific zone. Access will be denied to any potential entrant not meeting these requirements.

As site conditions warrant, the work zones listed below will be established.

Exclusion Zone (EZ) - This is the area where contamination does or could occur and will include all areas where PPE is required to control worker exposure to chemical or physical hazards. As applicable to this scenario, the primary hazard is the explosive hazards presented by the presence of UXO/OE.

Contamination Reduction Zone (CRZ) - The outer boundary of the Exclusion Zone is called the Contamination Reduction Zone (CRZ). This boundary (a.k.a. frag zone) shall be determined from the projected explosive weight, the potential for contaminant release (activation), site topography, meteorological conditions, and nature of site activities. This zone is a buffer between the EZ and the Support Zone and will contain the site access corridor through which the UXO Supervisor controls entrance to the EZ. The CRZ will be the minimal withdrawal distance required for all guests and nonessential personnel. This CRZ can be reduced in size if natural contours/barriers are present.

Support Zone (SZ) - The SZ is the area outside the CRZ where site support activities are conducted. This zone may include storage/office buildings, break areas and sanitation facilities. Persons desiring entrance into the EZ must meet with the UXOSSO and receive the appropriate safety briefing in the SZ before gaining admittance to the EZ.

### **3.1 Buddy System**

During all UXO activities, or when particular conditions present a risk to personnel, the buddy system will be implemented. A buddy system requires that two people work as a team, each looking out for the other. Buddies must maintain continuous line-of-sight contact with one another and be in a position to physically assist should rescue be necessary.

During all other activities, all personnel will be paired with another person and/or will be in direct contact with either the Project Manager or the Site Safety Officer *via* portable radios.

### **3.2 General UXO Safe Work Practices**

The following safety requirements are based on standard UXO precautions. These safety requirements have been established and test-proven under previous UXO operations.

- a. Only qualified UXO personnel will be permitted on the site during UXO excavation operations.
- b. Use of CB radios or other radio communication devices rated above 5 watts will not be permitted during UXO excavation operations.
- c. All safety precautions related to UXOs will be observed.
- d. The Senior UXO Supervisor will be in charge of all site UXO operations. Safety responsibilities of the Senior UXO Supervisor and UXO Safety Officer are as follows:
  - 1) When and if required, ensure that all barricades are in place prior to the start of any UXO operations.
  - 2) Ensure that all personnel in the area of UXO operations are qualified UXO or EOD personnel.
  - 3) Ensure that adequate emergency fire/rescue, medical, and security support is available.
  - 4) Have absolute authority to stop all operations and order the immediate evacuation of the project site in the event that UXO or suspected UXO is located.

UXO contractors on site may establish additional safety requirements in their site-specific SHERP and their Ordnance Remediation Plan if applicable.

## **4. EMERGENCY RESPONSE/CONTINGENCY PLAN**

This subsection describes contingencies and emergency planning procedures to be implemented at the survey site. During the initial site briefing and daily tailgate briefings, all on-site personnel will be trained in and reminded of the provisions of this emergency response plan, the communication systems, and the evacuation routes. The plan will be reviewed and revised, if necessary, by the Site Safety Officer to ensure that it is up-to-date and appropriate for the prevailing site conditions.

The Project Manager and the Site Safety Officer have the primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and visitors. Possible actions may involve evacuation of personnel from the site area and evacuation of adjacent residents. The SSO is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The Senior UXO Supervisor has the responsibility to deal with situations in connection with UXOs but will keep the SSO informed at all times of all actions.

In the event of an emergency that necessitates an evacuation of the site, portable radios and a portable air horn will be used to alert site personnel of an evacuation emergency. Two sustained blasts followed by one or two blasts will notify all personnel to exit the site to the meeting areas through the contamination reduction zone, if required. The one or two blasts following the two sustained blasts will indicate gathering at the primary or secondary evacuation point. For example, two sustained blasts, followed by one blast, will indicate evacuation to the primary meeting area. The primary and secondary meeting areas will be established on a site-specific basis during the daily tailgate safety briefing. A head count will be completed by the SSO at the meeting area and further directions or response discussions coordinated at that point.

Following an emergency alarm signal, access to the area of the incident will be restricted. Physical barriers or banner tape will be used to delineate restricted areas. Site control is the responsibility of the SSO who will establish the new work area boundaries, if necessary. Future entries into restricted areas will require permission from the SSO.

### **4.1 Fire or Explosion**

In the event of a fire, the local or designated Fire Department or appropriate agency will be summoned immediately following a head count and evacuation. Upon their arrival, the SSO, or designated alternate, will advise the fire commander of the location, nature, and identification of the hazardous materials on-site.

If the site is known to contain hazardous chemicals, and due to the nature of the possible contaminants, on-site fires can only be put out from an upwind position unless appropriate level of protection and breathing apparatus are worn by the personnel fighting the fire.

Upon approval of the SSO, and providing it can be done safely, site personnel may:

- a. Use available fire extinguisher on-site to control or extinguish a small-localized fire.



- b. Remove or isolate flammable or other hazardous materials that may contribute to the fire.

In the event of an explosive accident/incident at a work site at which a UXO operation is being performed, the UXO Safety Officer/Senior UXO Supervisor, or in his absence the UXO Supervisor, will act as the On-Site Coordinator until the emergency response teams arrive at the scene. They will direct emergency response operations to include the evacuation of personnel, and other actions to mitigate property and material loss.

ABC-Type, dry chemical, portable fire extinguishers will be provided on all motorized field equipment, at the work location, and in the immediate place where flammable materials are located.

## **4.2 Injury/Medical Emergency**

### **4.2.1 Emergency Services**

The Regional Trauma Center is located in Albuquerque, at 2211 Lomas Blvd, NE: telephone **(505)-272-2411**. Emergency situations on the survey site will be coordinated through the **Pueblo Police Department** at **505-869-3030**. Liaison will be made with emergency personnel and facilities prior to the start of initial site activities.

### **4.2.2 Physical Injury**

If a person is physically injured, first-aid procedures are to be followed. Depending on the severity of the injury, emergency medical response from the Regional Trauma Center (University Hospital) may be sought. The designated and qualified first aid technician should be sought to stabilize victim for transport to the hospital. If the individual can be moved, administer emergency first aid and transport to the local emergency medical facility.

### **4.2.3 Chemical Injury**

If the injury to an individual is chemical in nature, the following first-aid procedures are to be instituted:

- a. Eye Exposure - If contaminated solid or liquid gets into the eyes, wash the eyes immediately using large amounts of water and lifting the lower and upper lids occasionally. Obtain medical attention.
- b. Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solids or liquids penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention.
- c. Swallowing - If contaminated solid or liquid has been swallowed immediately contact the Regional Poison Control Center at 1-800-962-1253. Do not make an unconscious person vomit.

- d. Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Obtain medical attention.

### **4.3 Medical Surveillance**

All field personnel directly involved with hazardous materials are subject to the medical surveillance program for hazardous waste site workers. This program is designed in accordance with the recommendations found in the National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Operations, and meets the requirements of 29 CFR 1910.120.

Medical examinations are provided for all hazardous waste personnel. A licensed physician who is familiar with the specific requirements of 29 CFR 1910.120 performs all medical examinations. The examining physician is provided with information on each person's duties as they relate to exposure, actual and anticipated exposure level data, and all applicable information from previous medical examinations. The examining physician will determine the exact content of the medical examination and consults. Upon completion of each examination, the physician shall furnish each individual with a copy of a written opinion that contains the following information:

- a. The results of the medical examination and laboratory tests.
- b. The physician's opinion as to whether the employee has any detected medical conditions that might impair the employee's health and/or restrict his/her work assignments.
- c. Each employee receives a copy of the physician's written opinion and data from all test results. Subcontractors must participate in an equivalent medical surveillance program and must provide a copy of the physicians written opinion to the Program Manager/Project Manager prior to commencement of any on-site work.

#### **4.3.1 Medical Examination**

The following examinations are covered in the Medical Examination and Monitoring Program.

- a. Basic physical exam
- b. Heart status and functions (electrocardiogram {EKG})
- c. Chest x-ray (Roentgenogram posterior-anterior)
- d. Pulmonary function-forced vital capacity, forced expiratory volume at 1 second and reserve volume
- e. Blood-full SMAC Series
  - (1) Hemoglobin-cell counts, protein levels

- (2) Acetylcholinesterase activity
- (3) Heavy metals
- (4) PCB in serum
- f. Liver function-full enzyme profile
- g. Renal function-blood, urea, nitrogen (BUN), creatinine, creatine/Creatinine ratio, lipoprotein count and differential, uric acid
- h. Urinalysis
- i. Audiometry-audio spectrum response of ear
- j. Eye-physical condition, visual acuity.

Training and medical records for applicable site personnel will be made available for inspection as required. Any additional subcontractors are required to have training and medical records available for inspection as required by this SHERP.

#### **4.4 Safety and Health Training/Hazard Communication**

##### **4.4.1 Comprehensive Health and Safety Indoctrination**

All personnel assigned to or regularly entering the hazardous segments of the site for the purpose of performing or supervising work; for health, safety, security, or administrative purposes; for maintenance; or for any other site-related function, will have received appropriate health and safety training in accordance with 29CFR 1910.120. Training will consist of a minimum of 40 hours of initial instruction off-site. All personnel will have received a minimum of 8 hours of refresher training each year. Documentation of all such training will be submitted to the Project Manager/SSO before being allowed at the site.

##### **4.4.2 UXO Orientation**

All site personnel and other subcontractor personnel will attend a UXO briefing presented by the Project Manager/SSO or his designated representative. This briefing is presented to introduce site personnel to the recognition of ordnance, ordnance-related items, associated hazards, and safety precautions. All personnel who require access to areas that contain UXOs or operations involving UXOs are required to be briefed and must acknowledge by signature in the Log Book. Any additional information obtained during site operations will be passed on to all concerned individuals as required.

#### **4.5 Heat/Cold Stress Monitoring**

The section of this document titled, Environmental Precautions contains the information concerning Heat/Cold Stress Monitoring.

#### **4.6 Accident Prevention Plan and Reporting**

Throughout the duration of this project, NRL will ensure that proper administrative and engineering control methods are applied daily to regulate all physical and chemical hazards present at the site. This will ensure that all health and safety concerns are identified and established, and this knowledge presented to all workers. The control measure include the following:

- a. Will ensure that all UXO and applicable workers have a minimum of 40 hours of health and safety training in accordance with OSHA 29 CFR 1910.120.
- b. All workers will be responsible for full comprehension of the site-specific SHERP before entering work areas.
- c. Before each workday, a daily "tailgate" meeting will be held between the UXO SSO and field crew personnel to review site activities and associated health and safety concerns for each task.

#### **4.7 Local Requirements: Noise Control, Traffic Control, and Marking of Hazards**

These site control measures are outlined in the subsections that follow.

##### **4.7.1 Noise Control**

Noise control measures include the following:

- a. All site activities will take place during normal, daytime working hours.
- b. Protection against the effects of noise exposure will be provided for all site personnel when necessary. Action levels will be established by referring to the USACE Safety and Health Requirements Manual (EM 385-1-1), Section 23, Noise Control, and regulatory requirements established by OSHA.
- c. Whenever noise levels exceed specified limits, feasible engineering or administrative controls will be utilized. According to OSHA regulations, 85 dB is the action level for 8-hour exposures. According to the U.S. Army Corps of Engineers Safety and Health Requirements Manual (EM 385-1-1), permissible noise exposure for 8 hours is 90 dB.
- d. When engineering controls are insufficient to regulate exposure to noise, hearing protection will be supplied to affected site workers.

##### **4.7.2 Traffic Control**

All normal work and site traffic will be regulated by the SSO. During all UXO activities, the UXO SSO will regulate work and site traffic. The Senior UXO Supervisor will coordinate its excavation activities with the UXO SSO to preclude traffic flow in immediate UXO work area. All other site traffic will be confined to the designated roads.

#### **4.7.3 Marking of Hazards**

During the UXO activities, UXO hazard areas will be marked appropriately by the Senior UXO Supervisor/UXO SSO and annotated on the project site map. During target marking, yellow flags will be used to denote the location of a "target." During subsequent excavation and upon identification, this flag may be replaced with the following colors:

Yellow Flag = Non-hazardous UXO/Scrap

Red Flag = Hazardous UXO awaiting EOD response

Any additional areas that impose a potential health hazard will be conveyed to the SSO for a final determination. Workers will be informed of the physical, chemical, and biological hazards contained within each area.

#### **4.8 Subcontractor Coordination**

All subcontractors assigned work on the survey site will follow directions from the Project Manager or designated representative. Any activities of the subcontractor in areas of UXO concern will be coordinated through the Senior UXO Supervisor and UXO Safety Officer. The efficient use of subcontractor resources will depend on advanced planning and coordination among all concerned parties.

#### **4.9 Housekeeping and Maintenance of Safe Access/Egress**

Housekeeping and maintenance of access/egress routes will be performed in accordance with the USACE Manual, EM 385-1-1. All work areas will be free of materials, supplies, and other obstructions. Tools, materials, extension cords, hoses, or debris will be kept out of the way so as not to cause a tripping or other hazard. Storage and construction areas will be kept free of accumulation of materials.

#### **4.10 Fire Protection and Emergencies**

It is a requirement of the Naval Research Laboratory to maintain a site free of fire hazards and to ensure that all site workers are trained in fire prevention. This includes the following:

- a. All flammable and combustible liquids shall be stored in proper containers and in a place considered safe for storage of flammable and combustible liquids, as designated in the Safety and Health Requirements Manual, EM 385-1-1, issued by USACE,

- b. No smoking will be authorized during or near any UXO excavation and/or handling activities.
- c. All immediate work sites will have a portable fire extinguisher, which will be inspected and maintained in accordance with Appendix L of the Safety and Health Requirements Manual issued by USACE and NFPA 10, Portable Fire Extinguisher.
- d. The Project Manager will ensure that the standards of fire prevention outlined in the USACE Safety and Health Requirements Manual, Section 12, Fire Prevention, will be followed for all work sites.

#### **4.11 Contingency Plans for Severe Weather**

In the event of severe weather, all site activities will cease and will not restart until it is deemed safe to operate in the field by the Project Manager or Site Safety Officer. Severe weather is considered as any type of climatic anomaly that adds a substantial additional, uncontrollable risk to the health and safety of the workers.

#### **4.12 Safety Inspections/Logs, Reports, and Record Keeping**

##### ***Daily Health and Safety Report***

The UXO Safety Officer or Designated Representative will generate a Daily Health and Safety Report only when site work has been conducted. This report documents the location of work, the weather, work performed by site personnel and any subcontractors, equipment utilized, PPE used, and any other pertinent data.

##### ***Accident/Incident Reports***

All accidents/incidents, including near misses, will be reported to the Project Manager, Site Safety Officer or UXO Safety Officer immediately. The Site Safety Officer (SSO) will immediately ensure that the necessary first aid and corrective actions have begun and, if necessary, emergency agencies have been called.

Any site personnel, including visitors and subcontractors who have an accident resulting in injury or loss or damage of property must fill out a Naval Research Laboratory Accident Report to be filed within 4 working days from the occurrence. The SSO should report the incident by telephone as early as possible.

The SSO will complete all required reports for all deaths, lost time accidents, or property damage. Employees who have lost time due to an accident must have a completed Incident Follow-up Report before they will be allowed to return to work at the site. In the event of an accident or some other incident, such as an explosion, theft of any hazardous waste/material, or a release of toxic chemicals, occurs during the course of the project, the Government Officer will

be notified immediately and will receive written notification within 24 hours. The report will include the following information:

- a. Name, organization, telephone number, and location.
- b. Name and title of person reporting the incident/accident.
- c. Date and time of incident/accident.
- d. Location of the incident/accident.
- e. Brief summary of incident/accident giving pertinent details, including type of operation ongoing at time of incident.
- f. Cause of incident/accident (if known).
- g. Casualties.
- h. Details of any existing chemical hazard or contamination.
- i. Estimated property damage, if applicable.
- j. Nature of damage; effect on schedule.
- k. Action taken by contractor to ensure safety and security.
- l. Other damage or injuries sustained (public or private).

### ***Medical Certifications***

All field personnel are required to receive medical monitoring on an annual basis as required by OSHA 29 CFR 1910.120. This is documented by medical certifications as signed by a physician.

### ***Training Logs***

The Daily Safety Orientation Log documents the daily site-specific safety training conducted by the SSO or the UXO SSO. Detailed are those personnel attending the training, the level of protection, topics of discussion, and questions of concern. In addition, accurate and complete logs of all hazardous waste management training, per 29 CFR 1910.120, for all site personnel will be maintained on-site and will be available for inspection.

## **5. EMERGENCY PROCEDURES**

### **5.1 On-Site Emergency**

On-site emergencies can range from minor cuts and scrapes to explosions, fires, and the release of hazardous materials. Minor incidents at hazardous waste sites can have serious consequences or may indicate the presence of a previously unknown health and safety hazard. Explosions, fires, and the possible release of hazardous materials not only involves site workers, but may affect the neighboring population and the environment. All incidents will be reported as soon as possible to the Project Leader, UXO Supervisor, and the Site Safety Officer who will determine the appropriate steps to be taken. When the incident is minor, the work may continue. When an incident is considered serious, work will be discontinued until the emergency situation has been brought under control, the incident has been evaluated, and any conditions which may have contributed to the emergency have been mitigated. All site incidents, including near-misses, will be investigated and documented.

### **5.2 Site Personnel and Lines of Authority**

A clear chain-of-command in emergency situations ensures clear and consistent communications between site personnel, and results in more effective response to the emergency situation. One individual may serve in one or more of the positions required. The primary duties of the Site Safety Officer is outlined below.

Site Safety Officer (SSO): Will direct all emergency response operations, designate duties to other site personnel, and serve as liaison with government officials and emergency response teams. The SSO will make initial contact with off-site emergency response teams (first aid, fire, police, etc.), make recommendations on work stoppage, and provide for on-site first aid and rescue.

### **5.3 Emergency Site Communications**

Normal site communications will be maintained by means of cellular phone in the Project Manager's Vehicle and two-way radios carried by crew. Emergency phone numbers are listed on a separate page. Emergency communications will be maintained by use of air horns kept in the support areas and with each work crew. Emergency hand signals will also be used when required. The emergency communications codes are given in Table 1, On-Site Emergency Communications.

### **5.4 Evacuation Procedures**

Most of surrounding sites are known to contain various types of unexploded ordnance (UXO). All movement on the site shall be along cleared roads and pathways when possible. Cleared roads and pathways are indicated on the site map. Evacuation from work sites shall be along the access paths cleared to the various work sites. Equipment from work sites shall be placed so as



not to impede emergency escape and evacuation along the cleared pathways. Evacuation routes from work areas shall be discussed daily as a part of the daily safety meeting.

Table B1 – On-Site Emergency Communications

| <i>AIR HORN SIGNAL</i> | <i>ACTION</i>                       |
|------------------------|-------------------------------------|
| THREE SHORT BLASTS     | SHUT DOWN EQUIPMENT, STAND BY RADIO |
| ONE LONG BLAST         | RETURN TO NEAREST SUPPORT ZONE      |
| CONTINUOUS LONG BLAST  | EVACUATE BY BEST, FASTEST ROUTE     |
| <i>HAND SIGNALS</i>    | <i>MEANING</i>                      |
| HAND GRIPPING THROAT   | OUT OF AIR; CAN'T BREATHE           |
| GRIP PARTNER'S WRIST   | LEAVE AREA IMMEDIATELY, NO DEBATE   |
| HANDS ON TOP OF HEAD   | NEED ASSISTANCE                     |
| THUMBS UP              | OK; I'M ALL RIGHT; I UNDERSTAND     |
| THUMBS DOWN            | NO; NEGATIVE                        |

## 5.5 Emergency First Aid

Procedures used in emergency situations will vary greatly with the severity and particulars of the situation. The Site Safety Officer will provide advice on procedures to be used in each emergency situation. General guidelines for first aid procedures are given below.

### *Inhalation Exposures*

If contact is made with inhalation hazards, the following procedures are applicable:

Remove the victim from the exposure area to an area with fresh air. Determine if the administration of CPR is necessary. If so, start and continue CPR until the emergency medical unit arrives; you are relieved; or become physically unable to continue. If CPR is not required, administer other first aid as indicated.

### *Contact Exposure*

Procedures for contact exposures involve removing the victim from the area and flushing affected area with water only. Be careful not to spread the contamination to other parts of the body. Consult references to determine if other solutions in lieu of soap and water is indicated.

### ***Physical Injury***

- a. If a physical injury occurs or worker collapses in a work area; first aid will be administered as indicated.
- b. If a physical injury occurs in a potentially contaminated area, care must be taken to prevent contact of any contaminant with open wounds. The wound can provide easy access to the body for chemicals which are not normally a skin absorption problem. Any required removal of clothing will be accomplished carefully to avoid additional injury and avoid any exposure of the wound to contaminants on the clothing.
- c. If a worker collapses or loses consciousness, determine if the administration of CPR is necessary. Administer and continue CPR until emergency medical units arrive. If CPR is not required, administer other first aid as indicated.

A first aid kit large enough to accommodate anticipated emergencies will be kept on-site. If any injury should require advanced medical assistance, the victim will be transported to the hospital. Each work site will have a vehicle for transportation to the hospital. **KEYS WILL BE LEFT IN OR NEAR THE IGNITION.**

### **5.6 Site Emergency Equipment**

The following emergency equipment(s) will be present on each project site. Each working team in the field will have their own individual First Air Kits, Fire Extinguishers, and Air Horns.

First aid kit

Fire extinguisher (A, B, C Type)

Hand-held eyewash

Air horn

### **5.7 Emergency Telephone Numbers**

Telephone numbers for medical fire and other emergencies will be available on site for use by all project personnel in the event of an emergency. All vehicles will contain a cellular phone (including the phone list) to allow emergency communications in the event of an accident. The telephone area code for this area is 505. Additional phone numbers are listed below.

Table B2 – Emergency Contact Numbers

| Agency  | Phone Number |
|---|--------------|
| Isleta Pueblo Police Department<br>(Coordinates all emergency response) | 505-869-3030 |
| Regional Trauma Center  | 505-272-2411 |
| Poison Control Center   | 404-588-4400 |

## 5.8 Directions to the Hospital

Directions to the Regional Trauma Center (University Hospital in Albuquerque), including the map shown in Figure B1, will be maintained at the project site. A copy of the map will also be kept in each site vehicle. To reach the hospital, exit the site by traveling south on the dirt access road. At the paved road, New Mexico 6, turn left (East) and travel 14 miles to Interstate 25. Go north on I25 to Exit 225 (Lomas Boulevard) in Albuquerque. At the bottom of the long exit ramp, turn right onto Lomas Boulevard as indicated by the signs for the Regional Trauma Center. Continue on Lomas for 1 mile. Just past the intersection with Yale, the emergency entrance to the hospital is on your left. After turning into the hospital, the emergency entrance is on your right.



Figure B1 – Area map showing the location of University Hospital in Albuquerque in relation to Site S-1

## 6. ENVIRONMENTAL PRECAUTIONS

### 6.1 Cold Stress

Field operations during winter months can create a variety of hazards. Frostbite, frostnip, and hypothermia can be experienced and, if not remedied, cause severe health effects and even death. Therefore, it is important that all employees are able to recognize the symptoms of these conditions and correct the problem as quickly as possible.

People working outdoors in temperatures at or below freezing may experience frostbite. Extreme cold for a short time may cause severe injury to the body surface or result in profound generalized cooling, causing death. Extremities such as fingers, toes, and ears are most susceptible. Prolonged exposure to extreme cold produces the following symptoms: shivering, numbness, low body temperature, drowsiness, and marked muscular weakness. Two factors influence the development of a cold injury: ambient temperature and wind velocity. Wind-chill is used to describe the chilling effect of moving air in combination with low temperatures. Figure B2 shows a wind-chill chart. As a general rule, the greatest incremental gain in wind-chill occurs when a wind velocity increases from 5 mph to 10 mph. Additionally, water conducts heat 240 times faster than air. Therefore, the body cools dramatically when personal protective equipment is removed and clothing underneath is perspiration-soaked.

There are three categories of cold-injury: frostnip, frostbite, and hypothermia.

- a. Frostnip - Frostnip is the initial symptoms of frostbite and is characterized by a whitened area of the skin accompanied by a burning or painful feeling.

**Emergency Care** - Warm the affected area either by body heat or warm (not hot) water.

- b. Frostbite - Frostbite is local tissue damage caused by exposure to low temperatures. Ice crystals form, either superficially or deeply, in the fluids and underlying soft tissue of the skin. The nose, cheeks, ears, fingers, and toes are most commonly affected.

#### **Frostbite Symptoms**

- 1) Skin is cold, hard, white and numb
- 2) Skin may be blistering
- 3) Victim may be in pain
- 4) In advanced cases, victim experiences mental confusion
- 5) Judgment impairment
- 6) Victim will stagger
- 7) Eyesight failure
- 8) Unconsciousness
- 9) Shock symptoms, followed by death



# Wind Chill Chart

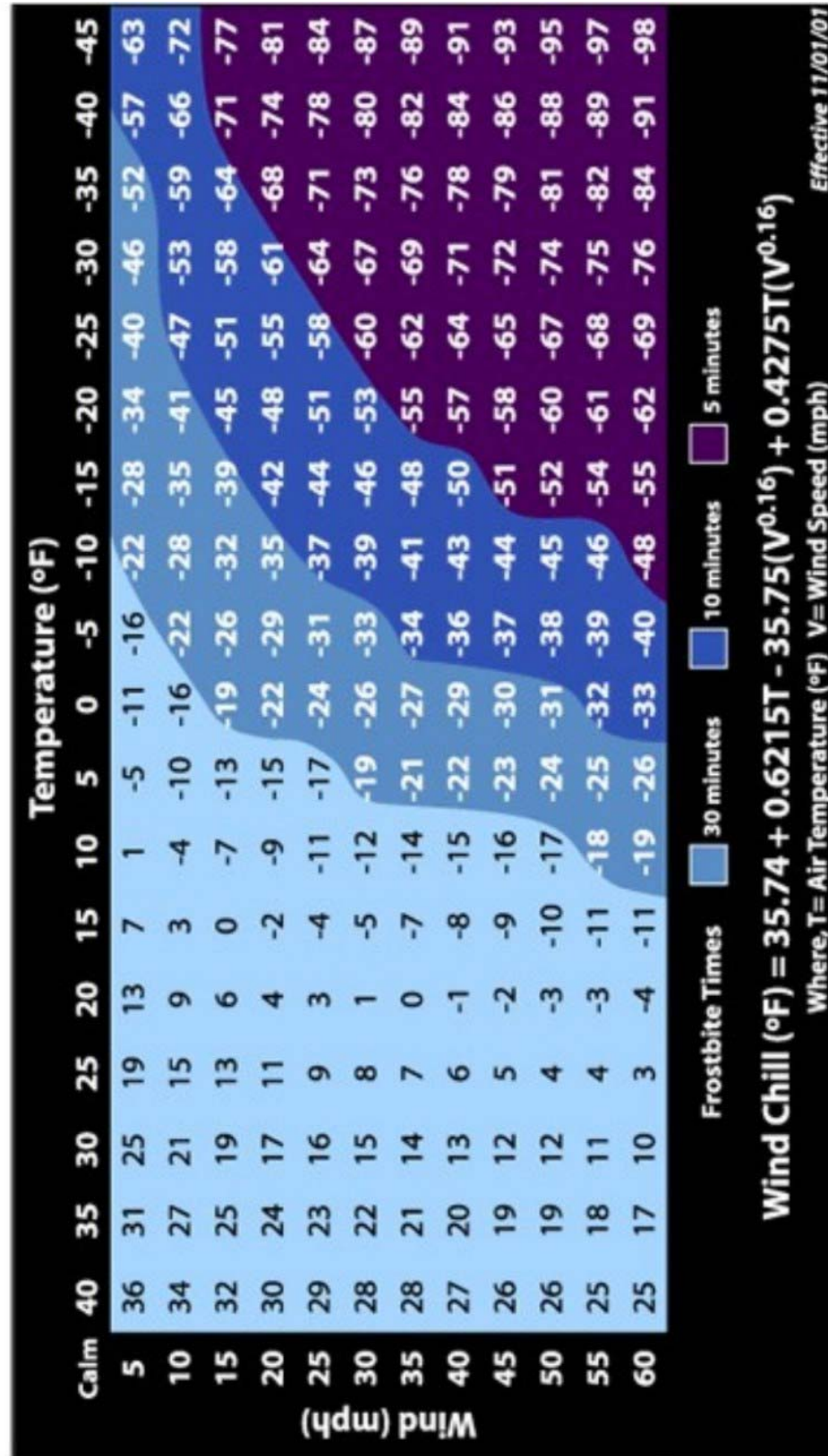


Figure B2 – NOAA Wind Chill Chart

## Emergency Care

1. Cover the frozen area and warm the victim with extra clothing and blankets. Bring the victim indoors (if possible) and allow victim to drink warm liquids.
  2. Rewarm the frozen area quickly by immersion in warm (NOT HOT) water. The best temperature is between 102°F and 103°F. This procedure may take up to thirty minutes. The victim will experience greater and greater pain as tissues thaw.
  3. If warm water is not available or not practical to use, wrap the affected area in a sheet and warm blankets.
  4. Severe swelling will develop rapidly after thawing. Discontinue warming the victim as soon as the affected area becomes flush.
  5. When the affected area has been warmed, have the victim exercise it. If the fingers or toes are involved, place dry, sterile gauze between the digits to separate them.
  6. If travel is necessary, cover the affected parts with sterile or clean clothes and keep the injured areas elevated. Obtain medical assistance as soon as possible.
  7. It is important during treatment that you do not:
    - Rub the affected area as rubbing may cause gangrene (tissue death).
    - Allow the victim to put the affected part near a hot stove or fire.
    - Break blisters.
    - Allow the victim to walk if the affected area is the feet.
    - Apply other dressings unless the victim is to be transported for medical aid.
    - Allow the victim to smoke or drink alcohol.
  8. It is important to protect the frozen area from further injury, to warm the affected area rapidly, and to maintain respiration. Never allow the affected area to refreeze. This may lead to further damage and result in eventual amputation. It is also important to remember that areas that have had frostbite are more susceptible to recurrent frostbite.
- c. Hypothermia - Hypothermia results from prolonged exposure to the cold thereby lowering the body's core temperature. Cold does not necessarily mean temperatures below freezing, as hypothermia can be caused by temperatures above 32°F when the person is hungry, wet, tired, and over-exerted. The target organ of hypothermia is the brain.



## **Hypothermia Symptoms**

1. Severe Shivering - During hypothermia the body's thermoregulatory mechanism may shut down. Shivering is the body's way of warming itself. At 95°F, the body will produce maximum shivering. At 87.8°F, the body loses its capacity to shiver. Table 2 lists the signs of hypothermia and suggested field treatments. The worker's exposure to cold should be immediately terminated when severe shivering becomes evident.
2. Abnormal behavior characterized by decreased efficiency, decreased level of communication, forgetfulness, repetitive behavior, poor motor skills, poor judgment, and general apathy.
3. Listlessness and sleepiness.
4. Weakness, inability to walk, and repeated falling.
5. Later stages include collapse, stupor, unconsciousness, and eventual death

## **Hypothermia Emergency Care**

All stages of hypothermia are treated by either passive or active rewarming and is accomplished by better conservation of the patient's body heat. However, the victim's thermoregulatory mechanisms must be intact. It is important to note that if a victim is found in a remote area, despite the death-like appearance, the person may be saved. All attempts should be made to revive the victim. Active rewarming means heat is applied to the victim by an external source, either superficially and/or through the core. Treatment includes:

1. Preventing further heat loss. Remove the victim to warm, dry place (out of the wind, cold, and rain/snow).
2. Remove wet clothing piece-by-piece and dry underlying skin.
3. Dress in several layers of warm, dry clothing, giving preference to the central body core rather than the extremities.
4. Cover the victim's head, then wrap victim in blankets.
5. If the victim is conscious allow him/her to drink hot fluids.
6. Monitor oral body temperature every 15 minutes. If body temperature falls below 96.8°F, the team member should not be allowed outside until body temperature returns to normal.
7. In more severe cases of hypothermia, implement the above treatment but also institute some type of active rewarming, including electric pads or blankets, hot-air blowers or heaters, heated blankets or clothes, and use of human body heat



8. It is important to watch for signs of return of the normal thermoregulatory mechanisms (shivering, teeth chattering, "goose flesh"), and to monitor mental status.
9. Victim should be transferred to a medical facility after the emergency care steps have been initiated and should not be allowed to return to work for at least 48 hours.
10. If there has been severe hypothermia, the victim should not be considered dead despite his/her appearance. Treat the victim as stated above and prepare for transfer to a medical facility. If the victim is pulseless and not breathing, perform CPR.

Table B3 – Signs of Hypothermia

| Core Temperature   |       | Signs/Symptoms   | Suggested Field Actions   |
|--|-------|--|---|
| °C   | °F    |  |   |
| 37.6   | 99.6  | "Normal" rectal temperature.                               |   |
| 37   | 98.6  | "Normal" oral temperature.                                 |   |
| 36   | 96.8  | Feel Cold  | Seek dry shelter, replace wet clothing, insulate whole body including HEAD from cold.                             |
| 35   | 95.0  | Shivering  |   |
| Body Core Temperature Below 35 °C/95 °F = HYPOTHERMIA = Hospital |       |  |   |
| 34   | 93.1  | Clumsy, Irrational, Confused (may appear drunk)            | No exercise, handle gently, rest. No external warmth (except to chest and trunk). Warm sweet drinks and calories. |
| 33   | 91.4  | Muscle Stiffness   | Monitor pulse, breathing. Restrict all activity; lie down with feet slightly raised.                              |
| 32   | 89.4  | Shivering Stops, Collapse.                                 | Transfer to Hospital. Urgent  |
| 31   | 87.8  | Semi-Conscious   | Nothing by mouth. Check airway remains open   |
| 30   | 86.0  | Unconscious  |   |
| 29   | 84.2  | Slow Pulse and Breathing                                   | Slow mouth-to-mouth breathing, at victim's own rate.  |
| 28   | 82.4  | Cardiac Arrest   | CPR   |
| <28  | <82.4 | NO VITAL SIGNS, COLD                                       | DO NOT GIVE UP TREATMENT  |
| 18   | 64.4  | Lowest accidental hypothermia victim to recover.           |   |
| 9  | 48.2  | Lowest artificially cooled hypothermia patient to recover. |   |

## Work Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. Table B4 lists Threshold Limit Values for working in the cold. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, is indications for immediate return to the shelter. When entering the heated shelter the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of diuretic and circulatory effect.

- a) For work practices at or below  $-12^{\circ}\text{C}$  ( $10^{\circ}\text{F}$ ), the following shall apply:
  - 1. The worker shall be under constant protective observation (buddy system or supervision).
  - 2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided
  - 3. New employees shall not be required to work full-time in cold in the first days until they become accustomed to the working conditions and required protective clothing
  - 4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker
  - 5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible
- b) Special caution shall be exercised when working with toxic substances. Cold exposure may require reduced exposure limits.
- c) Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required where there is an expanse of snow coverage causing a potential eye exposure hazard.

Table B4 – Work/Warm-up Schedule

| Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift |                |                                 |               |                                 |               |                                 |               |                                 |               |                                 |               |
|--|----------------|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|---------------------------------|---------------|
| Air Temperature – Sunny Sky                                      |                | No Noticeable Wind              |               | 5 mph Wind                      |               | 10 mph Wind                     |               | 15 mph Wind                     |               | 20 mph Wind                     |               |
| °C (approx)  | °F (approx)    | Max Work Period                 | No. of Breaks | Max Work Period                 | No. of Breaks | Max Work Period                 | No. of Breaks | Max Work Period                 | No. of Breaks | Max Work Period                 | No. of Breaks |
| -26° to -28°   | -15° to -19°   | Normal Breaks                   |               | Normal Breaks                   |               | 75 min                          | 2             | 55 min                          | 3             | 40 min                          | 4             |
| -29° to -31°   | -20° to -24°   | Normal Breaks                   |               | 75 min                          | 2             | 55 min                          | 3             | 40 min                          | 4             | 30 min                          | 5             |
| -32° to -34°   | -25° to -29°   | 75 min                          | 2             | 55 min                          | 3             | 40 min                          | 4             | 30 min                          | 5             | Non-emergency work should cease |               |
| -35° to -37°   | -30° to -34°   | 55 min                          | 3             | 40 min                          | 4             | 30 min                          | 5             | Non-emergency work should cease |               |                                 |               |
| -38° to -39°   | -35° to -39°   | 40 min                          | 4             | 30 min                          | 5             | Non-emergency work should cease |               |                                 |               |                                 |               |
| -40° to -42°   | -40° to -44°   | 30 min                          | 5             | Non-emergency work should cease |               |                                 |               |                                 |               |                                 |               |
| -43° and below   | -45° and below | Non-emergency work should cease |               |                                 |               |                                 |               |                                 |               |                                 |               |

d) Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.
2. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every four hours.
3. In indoor workplaces, the wind speed should be recorded at least every four hours whenever the rate of air movement exceeds two meters per second (5 mph).
4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).
5. The equivalent chill temperature shall be obtained from Table C-2 in all cases where air movement measurements are required, and shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).
6. Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from disease or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than 5 mph, or air temperatures below -18°C (0°F) with wind speeds above 5 mph should be medically certified as suitable for such exposures.
7. Trauma sustained in freezing or sub-zero conditions requires special attention, because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing for first aid treatment.

## **6.2 Heat Stress**

Field operations during the summer months can create a variety of hazards to the employee. Heat cramps, heat exhaustion, and heat stroke can be experienced; and if not remedied, can threaten life or health. Therefore, it is important that all employees be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

## **6.3 Effects of Heat**

As the result of normal oxidation processes within the body, a predictable amount of heat is generated. If the heat is liberated as it is formed, there is no change in body temperature. If the heat is liberated more rapidly, the body cool to a point at which the production of heat is accelerated and the excess is available to bring the body temperature back to normal.

Interference with the elimination of heat leads to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. When such a condition exists, it produces a vicious cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal, but also the additional quantities of heat.

Heat produced within the body is brought to the surface largely by the bloodstream and escapes to the cooler surroundings by conduction and radiation. If air movement or a breeze strikes the body, additional heat is lost by convection. However, when the temperature of the surrounding air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture or sweat from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slows down. Thus, on a day when the temperature is 95 to 100°F, with high humidity and little or no breeze, conditions are ideal for the retention of heat within the body. It is on such a day, or more commonly a succession of such days (a heat wave), that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke. A chart of the danger zones is shown in Figure 3.

- a. Heat Cramps - Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps also may result from drinking iced water or other drinks either too quickly or in too large a quantity.

#### **Heat Cramp Symptoms**

- 1) Muscle cramps in legs and abdomen
  - 2) Pain accompanying the cramps
  - 3) Faintness
  - 4) Profuse perspiration
- b. Heat Exhaustion - Heat exhaustion occurs in individuals working in hot environments, and may be associated with heat cramps. The pooling of blood in the vessels of the skin causes heat exhaustion. The heat is transported from the interior of the body to the surface by the blood. The blood vessels in the skin become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood pooled in the lower extremities when an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

#### **Heat Exhaustion Symptoms**

- 1) Weak pulse
- 2) Rapid and usually shallow breathing
- 3) Generalized weakness

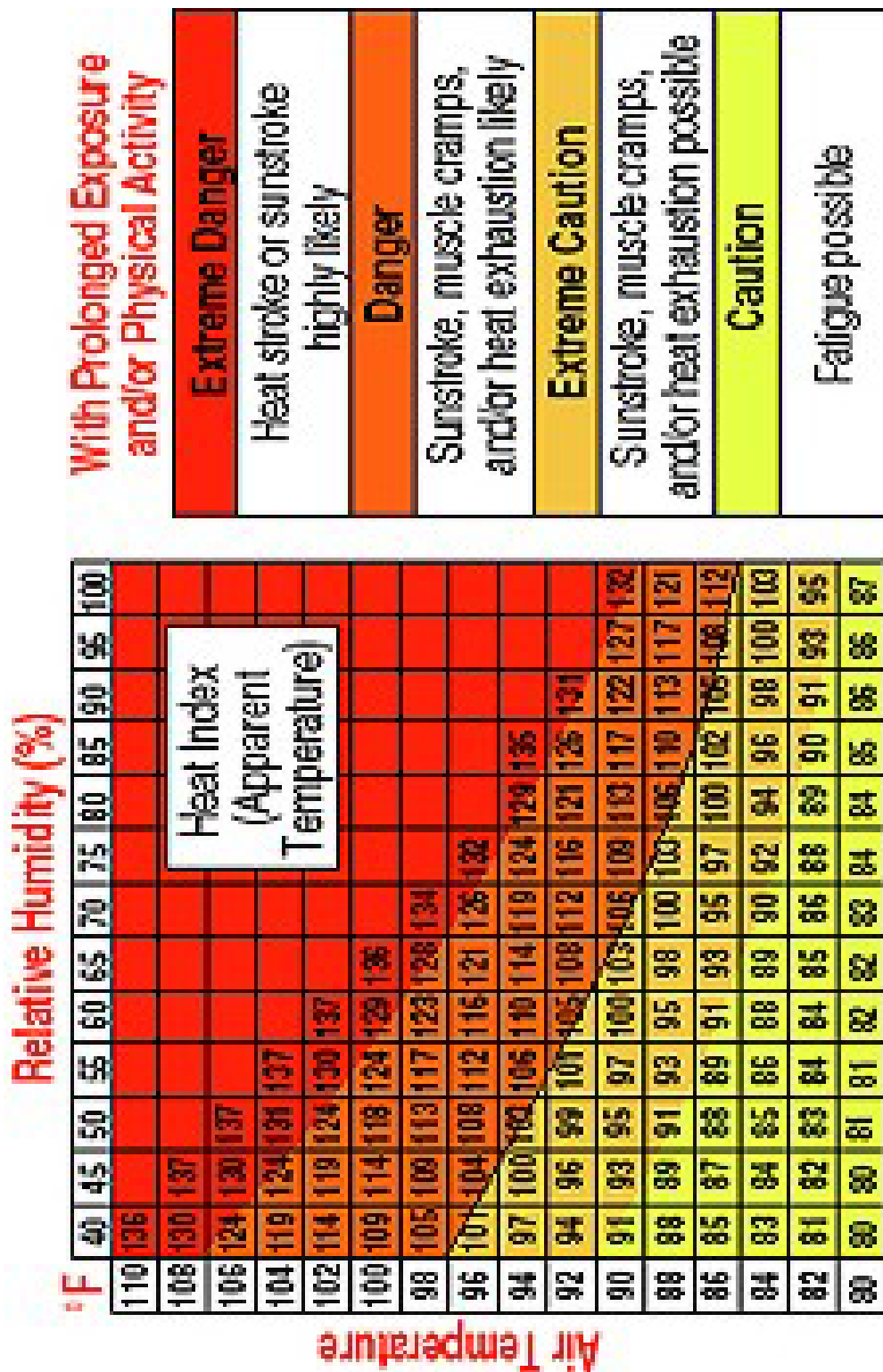


Figure B3 – Heat Index Chart

- 4) Pale, clammy skin
- 5) Profuse perspiration
- 6) Dizziness
- 7) Unconsciousness
- 8) Appearance of having fainted (the patient responds to the same treatment administered in cases of fainting).

### **Heat Exhaustion Emergency Care**

- 1) Remove the patient to a cool place and remove as much clothing as possible.
  - 2) Administer cool water, "Gatorade," or its equivalent.
  - 3) If possible, fan the patient continually to remove heat by convection, but do not allow chilling or overcooling.
  - 4) Treat the patient for shock, and remove him/her to a medical facility if there is any indication of a more serious problem.
- c. Heat Stroke - Heat stroke is a profound disturbance of the heat-regulating mechanism, associated with high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) bear directly on the tendency to heat stroke. It is a serious threat to life and carries a 20 percent mortality rate. Alcoholics are extremely susceptible.

### **Heat Stroke Symptoms**

- 1) Sudden onset
- 2) Dry, hot, and flushed skin
- 3) Dilated pupils
- 4) Early loss of consciousness
- 5) Full and fast pulse
- 6) Breathing deep at first, later shallow and almost absent
- 7) Muscle twitching, growing into convulsions
- 8) Body temperature reaching 105 to 106°F or higher

## **Heat Stroke Emergency Care**

- 1) Remember that this is a true emergency.
- 2) Transportation to a medical facility should not be delayed.
- 3) Remove the patient to a cool environment if possible, and remove as much clothing as possible.
- 4) Assure an open airway.
- 5) Reduce body temperature promptly, preferably by wrapping in a wet sheet or else by dousing the body with water.
- 6) If cold packs are available, place them under the arms, around the neck, at the ankles, or at any place where blood vessels that lie close to the skin can be cooled.
- 7) Protect the patient from injury during convulsions, especially from tongue biting.

## ***Avoidance of Heat-Related Emergencies***

Please note that in the case of heat cramps or heat exhaustion, "Gatorade" or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid is that such beverages will return much-needed electrolytes to the system. Without these electrolytes, body systems cannot function properly, thereby increasing the represented health hazard. Therefore, when personnel are working in situations where the ambient temperatures and humidity are high, and especially in situations where protection Levels A, B and C are required, the site safety officer must:

- a. Assure that all employees drink plenty of fluids ("Gatorade" or its equivalent).
- b. Assure that frequent breaks are scheduled so overheating does not occur.
- c. Revise work schedules, when necessary, to take advantage of the cooler parts of the day (e.g. 5:00 am to 1:00 pm and 6:00 pm to nightfall).
- d. Assure that workers are acclimated before allowing them to work for extended periods. Heat induces a series of physiological and psychological stresses that the individual worker must adjust to during the first week of heat exposure. Workers should slowly work into their peak work performance over a two-week period. Workers absent from the site several days must be allowed to become reacclimated.

## ***Rest-Recovery Regime***

One method of measuring the effectiveness of employees' rest-recovery regime is by monitoring the heart rate. The "Brouha Guideline" is one such method.



- a. During a three minute period, count the pulse rate for the last 30 seconds of the first minute, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- b. Double the count.
- c. If the recovery pulse rate during the last 30 seconds of the first minute is 110 beats/minute or less, and the deceleration between the first, second and third minutes is at least 19 beats/minute, the work-recovery regime is acceptable. If the employee's rate is above that specified, a longer rest period is required, accompanied by an increased intake of fluids.

## **Appendix C. On-Site Documentation Forms**



## ON-SITE SAFETY MEETING RECORD

(Page 1 of 2)

PROJECT NAME:

JOB NO.

DATE:

TIME:

LOCATION:

REASON FOR MEETING: (check all that apply)

☐ Initial site safety briefing.

☐ Periodic safety meeting.

☐ Beginning of new task. Task:

☐ New site procedures.

☐ New site information.

☐ Review of Site incident.

☐ Other (explain)

### MEETING ATTENDEES:

|    | Name | Affiliation |
|----|------|-------------|
| 1  |      |             |
| 2  |      |             |
| 3  |      |             |
| 4  |      |             |
| 5  |      |             |
| 6  |      |             |
| 7  |      |             |
| 8  |      |             |
| 9  |      |             |
| 10 |      |             |
| 11 |      |             |
| 12 |      |             |
| 13 |      |             |

**ON-SITE SAFETY MEETING RECORD**  
(Page 2 of 2)

PROJECT NAME:

JOB NO.

DATE:

TIME:

LOCATION:

**SAFETY PROJECTS PRESENTED:**

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Site Safety Personnel            | <input type="checkbox"/> Decontamination Procedures      | <input type="checkbox"/> Site Description              |
| <input type="checkbox"/> Emergency Response Plan          |  | <input type="checkbox"/> Work Area Description         |
| <input type="checkbox"/> Emergency Response Personnel     | <input type="checkbox"/> Site Characterization           | <input type="checkbox"/> On-Site Emergency             |
| <input type="checkbox"/> Work Area Characterization       | <input type="checkbox"/> Off-Site Emergency              | <input type="checkbox"/> Chemical Hazard Evaluation    |
| <input type="checkbox"/> Site Evacuation Procedures       |  |  |
| <input type="checkbox"/> Physical Hazard Evaluation       | <input type="checkbox"/> Work Area Evacuation Procedures | <input type="checkbox"/> Safe Work Practices - Task    |
| <input type="checkbox"/> Toxicological Review             | <input type="checkbox"/> Places of Refuge                | <input type="checkbox"/> Heat Stress                   |
| <input type="checkbox"/> Emergency Decontamination        | <input type="checkbox"/> Cold Stress                     | <input type="checkbox"/> Emergency Equipment           |
| <input type="checkbox"/> Site Layout and Control Measures | <input type="checkbox"/> Emergency Telephone Numbers     | <input type="checkbox"/> Work Zones                    |
| <input type="checkbox"/> Directions to Hospital           | <input type="checkbox"/> Personnel Protective Equipment  | <input type="checkbox"/> Medical Monitoring            |
| <input type="checkbox"/> Air Monitoring                   | <input type="checkbox"/> Training                        | <input type="checkbox"/> Safe Work Practices - General |

Other Topics or Notes:

NAME OF PRESENTER: \_\_\_\_\_

TITLE OF PRESENTER: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

## INCIDENT REPORT

(Page 1 of 6)

Report #

Date of Report:

SITE:

SITE LOCATION:

REPORT PREPARED BY: \_\_\_\_\_

(Printed Name/Title)

### INCIDENT CATEGORY

(Check all that apply)

- |  |  |  |
|--|--|--|
| <input type="checkbox"/> Injury        | <input type="checkbox"/> Illness           | <input type="checkbox"/> Property Damage   |
| <input type="checkbox"/> Near Miss     | <input type="checkbox"/> Fire              | <input type="checkbox"/> Chemical Exposure |
| <input type="checkbox"/> Motor Vehicle | <input type="checkbox"/> On Site Equipment | <input type="checkbox"/> Electrical        |
| <input type="checkbox"/> Mechanical    | <input type="checkbox"/> Explosive         | <input type="checkbox"/> Death             |
| <input type="checkbox"/> Other         |  |  |

DATE AND TIME OF INCIDENT:

### Narrative Report of Incident:

(Provide sufficient detail so that the reader may fully understand the actions leading to or contributing to the incident, the occurrence, and actions following the incident. Append additional sheets of paper if necessary.)

## INCIDENT REPORT

(Page 2 of 6)

### WITNESS TO INCIDENT

1. NAME: COMPANY:  
ADDRESS: PHONE:  
2. NAME: COMPANY:  
ADDRESS: PHONE:

### INJURIES:

#### FIRST INJURED PERSON

Name and Address of Injured

SSN: Age: Sex:

Time on Present Job: Title/Classification:

Severity of Injury/ Illness: ☐ Disability ☐ Non-disability ☐ Fatality ☐ Medical Treatment

Estimated Number of Days Away from Job:

Nature of Injury or Illness:

#### Classification of Injury:

|  |   |  |
|--|---|--|
| <input type="checkbox"/> Fracture            | <input type="checkbox"/> Heat Burns                 | <input type="checkbox"/> Cold Exposure   |
| <input type="checkbox"/> Dislocations        | <input type="checkbox"/> Chemical Burns             | <input type="checkbox"/> Frostbite       |
| <input type="checkbox"/> Sprains             | <input type="checkbox"/> Bruises                    | <input type="checkbox"/> Heat Exhaustion |
| <input type="checkbox"/> Lacerations         | <input type="checkbox"/> Blisters                   | <input type="checkbox"/> Concussion      |
| <input type="checkbox"/> Punctures           | <input type="checkbox"/> Bites                      | <input type="checkbox"/> Faint/Dizziness |
| <input type="checkbox"/> Respiratory Allergy | <input type="checkbox"/> Toxic Respiratory Exposure | <input type="checkbox"/> Toxic Ingestion |

**INCIDENT REPORT**  
(Page 3 of 6)

Part of Body Affected:

Degree of Disability:

Location/Address (if off-site):

If Hospitalized:

Name/ Address/Telephone Number of Hospital:

Name/Address/Telephone Number of Physician:

SECOND INJURED PERSON

Name and Address of Injured

SSN:

Age:

Sex:

Time on Present Job:

Title/Classification:

Severity of Injury/ Illness:   ☐ Disability   ☐ Non-disability   ☐ Fatality   ☐ Medical Treatment

Estimated Number of Days Away from Job:

Nature of Injury or Illness:



## INCIDENT REPORT

(Page 4 of 6)

### Classification of Injury:

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> Fracture            | <input type="checkbox"/> Heat Burns                 | <input type="checkbox"/> Cold Exposure   |
| <input type="checkbox"/> Dislocations        | <input type="checkbox"/> Chemical Burns             | <input type="checkbox"/> Frostbite       |
| <input type="checkbox"/> Sprains             | <input type="checkbox"/> Bruises                    | <input type="checkbox"/> Heat Exhaustion |
| <input type="checkbox"/> Lacerations         | <input type="checkbox"/> Blisters                   | <input type="checkbox"/> Concussion      |
| <input type="checkbox"/> Punctures           | <input type="checkbox"/> Bites                      | <input type="checkbox"/> Faint/Dizziness |
| <input type="checkbox"/> Respiratory Allergy | <input type="checkbox"/> Toxic Respiratory Exposure | <input type="checkbox"/> Toxic Ingestion |

Part of Body Affected:

Degree of Disability:

Location/Address (if off-site):

### If Hospitalized:

Name/ Address/Telephone Number of Hospital:

Name/Address/Telephone Number of Physician:

If more than two injuries, provide information on separate sheet(s)

## **INCIDENT REPORT**

(Page 5 of 6)

### PROPERTY DAMAGE

Brief Description of Property Damage:

Estimate of Damage: \$

INCIDENT LOCATION:

INCIDENT ANALYSIS:

Causative Agent most directly related to accident (object, substance, material, machinery, equipment, conditions):

Was weather a factor?:        ☐ Yes        ☐ No

Unsafe mechanical/physical/environmental condition at time of accident (Be Specific):

Unsafe act by injured and/or others contributing to the accident (Be Specific, must be answered):

Personal factors (Improper attitude, lack of knowledge or skill, slow reaction, fatigue):

## INCIDENT REPORT

(Page 6 of 6)

### ON SITE INCIDENT:

Level of personal protection equipment required in Site Safety Plan:

Modifications:

Was injured using required equipment?:

If not, how did actual equipment use differ from plan?:

### ACTION TAKEN TO PREVENT RECURRENCE:

(Be specific. What was or will be done/When will it be done/Who is the responsible to ensure correction is made?)

### INCIDENT REPORT COMPLETED BY:

SSO Name (Printed)

SSO Signature

### OTHERS PARTICIPATING IN INVESTIGATION:

Name (Printed)

Signature

Title

Name (Printed)

Signature

Title

Name (Printed)

Signature

Title

## INCIDENT FOLLOW-UP REPORT

Incident Number:

Date of Incident:

Site Name:

Project Number:

Prepared By:

Date:

Outcome of Incident:

### Physician's Recommendations:

First Injured Person:

Second Injured Person:

Other Injured Person(s):

### Date Returned to Work:

First Injured Person:

Second Injured Person:

Other Injured Person(s):

Have corrective actions been implemented? If not, explain why not. What alternative actions have been taken?

Investigation Team:

Name (Printed)

Signature

Title

ATTACH ANY ADDITIONAL INFORMATION



## SITE ENTRY/EXIT LOG

**SITE:**

**LOCATION:**

**DATE:**

| <b>Name</b> | <b>Company/Position</b> | <b>Time In</b> | <b>Time Out</b> |
|-------------|-------------------------|----------------|-----------------|
|             |                         |                |                 |
|             |                         |                |                 |
|             |                         |                |                 |
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|             |                         |                |                 |
|             |                         |                |                 |



## HEAT STRESS MONITORING

NAME

DATE/TIME:

COMPANY:

SITE:

LOCATION

Pulse Rate Monitoring (30 second rest prior to first measurement):

Starting Time: \_\_\_\_\_ Pulse Rate: \_\_\_\_\_ beats/minute:

rest 30 sec: \_\_\_\_\_ rest 30: \_\_\_\_\_ b/s;

rest 30 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

rest 60 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

Starting Time: \_\_\_\_\_ Pulse Rate: \_\_\_\_\_ beats/minute:

rest 30 sec: \_\_\_\_\_ rest 30: \_\_\_\_\_ b/s;

rest 30 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

rest 60 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

Starting Time: \_\_\_\_\_ Pulse Rate: \_\_\_\_\_ beats/minute:

rest 30 sec: \_\_\_\_\_ rest 30: \_\_\_\_\_ b/s;

rest 30 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

rest 60 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

Starting Time: \_\_\_\_\_ Pulse Rate: \_\_\_\_\_ beats/minute:

rest 30 sec: \_\_\_\_\_ rest 30: \_\_\_\_\_ b/s;

rest 30 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

rest 60 sec: \_\_\_\_\_ rest 60: \_\_\_\_\_ b/s;

Method of Measurement:

Carotid Artery:

Instrument (specify type):

Self-Determined and Reported:

Site Safety Officer:

**Site Safety Officer (SSO)/Designated Representative**





## **Appendix D. Aircraft Safety Procedures and Search and Rescue Form**

### **1. Introduction**

The following section is intended to address health and safety issues specific to very low-level airborne geophysical investigations for detection of UXO. In this section we will address guidelines for conducting low-level survey operations, potential hazards associated with rotorcraft operations, and emergency response procedures. As in all airborne operations, final decisions regarding safety of the aircraft, crew and passengers are the responsibility of the aircraft operator and the pilot in command. In addition, compliance with the Federal Aviation Administration (FAA) regulations and standards for civilian aircraft operations, and FAA approved aircraft specific maintenance procedures and flight manuals is mandatory.

### **2. Guidelines for Conducting Helicopter Survey Operations**

The following are general guidelines for performing airborne survey operations:

The pilot in command has complete jurisdiction over all aircraft related operations, emergency response activities and requirements.

No aircrew member will fly while under the influence of substances, including alcohol and illegal, prescription, or over the counter drugs, which may impair physical or mental acuity.

The aircraft operator shall maintain up to date insurance.

Daily inspections and preflight inspections of aircraft and equipment installations will be performed pursuant to manufacturer's specifications.

Flight plans are to be filed as appropriate. Where flight plans are required by local authorities, a company flight plan will be made and monitored.

Preflight briefings are to be performed prior to each survey flight. Ground crew must be aware of planned flight activities, fuel reserves, and estimated return times.

Weight and balance calculations must be performed after any modification to the aircraft, including initial installation of any survey equipment.

Only necessary personnel are permitted to on board during flight operations.

The pilot in command has the authority to abort any flight for safety considerations.

The pilot in command may deviations from survey specifications (speed, altitude, flight duration) for safety considerations.

Over-flight of restricted areas may only be performed with authorization from the appropriate authorities.

Fueling is to be performed by qualified personnel only. Non-qualified personnel must stay clear of the aircraft during fueling operations.

All survey equipment is to be turned off during fueling operations.

Daily weather forecasts are to be obtained prior to commencement of survey operations.

Site-specific hazards will be addressed prior to commencement of survey operations.

Proper hearing protection is to be worn by personnel working near the aircraft while the engine is running.

During landing and takeoff maneuvers, ground personnel will remain well clear of the aircraft. If proximity to the helicopter is necessary, proper eyewear is required to protect against flying debris caused by rotor downwash.

### **3. Airborne Survey Specific Hazards**

#### **3.1 Injury due to Contact with Main or Tail Rotor**

##### **Description**

During ground run up of the aircraft, the main rotor and tail rotor present a very real risk to personnel working near the aircraft. Under certain conditions, the main rotor may reach as low as head high on the average adult. The tail rotor is almost invisible while it is spinning. Contact with either rotor can be fatal.

##### **Mitigation**

In light of this risk, the following rules must be obeyed while the rotors are turning:

- Only personnel essential to the survey operation may approach the aircraft.
- Never approach the rear of the aircraft.
- Never approach or leave the aircraft without the pilot's knowledge – always approach and leave the aircraft within sight of the pilot.
- Never throw anything to or from the aircraft.
- Loose clothing, specifically hats or scarves, must not be worn near the aircraft.
- If long items (survey poles etc) must be handled near the aircraft, they must be kept horizontal.

### **3.2 Controlled Flight into Terrain (CFIT)**

#### **Description**

The term ‘controlled flight into terrain’ is used to describe accidents where mechanical failure did not cause the aircraft to hit the ground. Low level, UXO style, survey operations bear an increased risk of CFIT due to:

- the extremely low altitudes required for this type of survey,
- the physical addition of the boom structure which significantly increases the lateral clearance required when flying near obstacles (e.g. trees and hills) as well as during banked turns, and
- the changes in aircraft flight characteristics due to the presence of the aforementioned boom.

#### **Mitigation**

Clearly one of the dominating factors in reducing the risk of CFIT lies with the skill level as well as mental and physical state of the pilot:

- Pilots must have a minimum of 2,000 total flight hrs including 1,000 hours on type (Bell 206L series) and 100 hrs geophysical survey experience. The 100 hr geophysical survey experience requirement may be waived if the pilot has over 4,000 total flight hrs.
- A single pilot shall be restricted to 6 hrs of flight time and 14 hrs of duty time (the reduction in flight time versus the FAA restriction of 8 hrs reflects the higher concentration levels required for low level surveys).
- If possible, two pilots will be used in an alternating flight format so that aircraft utilization may be maximized without compromising pilot rest periods or daily flight hour restrictions.
- During each flight the pilot will take a five minute ‘high altitude’ break every hour, or more frequently if judged necessary by the pilot.
- Each pilot will be allowed adequate time to become comfortable with the aircraft flight characteristics and navigation system prior to attempting very low level survey flying.

The nature of the survey also requires stricter limits on environmental conditions. Survey flights will be terminated when:

- cross winds exceed 20 kts or are deemed by the pilot to be too unpredictable to continue low level surveys,
- visibility is less than 2 miles, or

- precipitation obscures the pilots view (even light precipitation will have a deleterious effect on visibility because the wind screen is not blown clean at low airspeeds.

By design, the boom is mounted in front of the aircraft to allow full view of the boom by the pilot during survey operations. Installation instructions for this survey modification are included as an attachment. The “Flight Manual Supplement”, included as an attachment, provides a description of flight limitations and procedures and performance imposed by the survey modification covered under FAA STC *SR01367NY*. The flight limitations are considered mandatory and must be complied with.

### **3.3 Mechanical Failure**

Second to pilot error, mechanical malfunction is a leading cause of rotorcraft accidents. The extensive nature of the modification to the airframe required for this project increases the level of risk.

#### **Mitigation**

It is the aircraft operator’s responsibility to ensure that all scheduled inspections and maintenance activities are performed in accordance to FAA and aircraft manufacture’s regulations.

Additional inspections of the survey modification FAA STC *SR01367NY* are required upon installation and periodically thereafter in accordance with document entitled “Instructions for Continued Airworthiness” (included as an attachment).

## **4. Emergency Response Procedures (Airborne Operations)**

These site specific emergency response procedures are intended to provide a preplanned course of action to cover aircraft related emergencies during survey operations. A list of contact numbers and pertinent information, (see SAR information form at the end of this Appendix) will be maintained at the base of operations. All actions will be initiated by the project manager on site. Conditions resulting in the invocation of these procedures are defined as Alert Levels I, II, or III. Definitions of each Alert Level and appropriate responses are provided as follows:

### **4.1 Level I - Overdue Aircraft:**

#### **Initiated by:**

A missed scheduled radio report or ETA by ten minutes.

#### **Objective:**

To ascertain if delays in reporting or arrival are due to communication difficulties, or diversion of aircraft due to weather or in-flight problems.

**Action:**

Request a communication search from local ATC authorities.  
Prepare for a ground search (where feasible).  
Take appropriate action, including progression to Alert Level II.  
Begin log of actions and timelines.

**4.2 Level II – Missing Aircraft****Initiated by:**

Missed scheduled radio report by 30 minutes,  
Missed ETA by 20 minutes,  
Receipt of radio report of problems in flight, or  
Failure to return after fuel supply including reserves is exhausted.

**Objective:**

Ascertain if the aircraft has landed at an alternate location.

**Action:**

Advise ATC and request action plan to be initiated.  
Call local SAR or emergency response teams and advise of overdue aircraft.  
Perform ground search of alternate landing sites.  
Take appropriate action, including progression to Alert Level III.  
Update log of actions and timelines.

**4.3 Level III – Missing Aircraft Presumed to have Crashed****Initiated by:**

Receipt of a MAYDAY, SOS, or ELT signal from the aircraft, or ground,  
Report of a distressed or downed aircraft, or  
Missed ETA by 30 minutes and failure to make radio or visual contact at alternate landing sites.

**Objectives:**

Locate downed aircraft as quickly as possible, ascertain medical requirements, and dispatch immediate medical help.

**Action:**

Provide location information (including last known position, and planned flight activities) as well as all pertinent flight plan information (helicopter type, registration, number of passengers) to Search and Rescue personnel.

When aircraft is located, note time, specific location, condition of crew and conditions around crash site including nearest landing zone and ground access routes.

Advise and update appropriate emergency personnel (local police, ambulance, fire department, ATC). Transfer command to trained SAR personnel (civil or military) at earliest possible time without compromising the above-mentioned objectives.

Continue detailed log of actions and timelines.

## Search and Rescue Information Form

### Base of Operations:

|                        |  |
|------------------------|--|
| Nearest Town           |  |
| Geographic Coordinates |  |
| Facilities             |  |
| Contact                |  |
| Telephone              |  |

### Aircraft Information:

|              |  |
|--------------|--|
| Make         |  |
| Model        |  |
| Registration |  |
| Operator     |  |
| Contact      |  |
| Telephone    |  |
| Fax          |  |
| Cellular     |  |

### Radio Frequencies:

|                |  |
|----------------|--|
| ATC 1          |  |
| ATC2/Community |  |
| Emergency      |  |

### Responsible SAR Agency:

|                  |  |
|------------------|--|
| Name             |  |
| Location         |  |
| Contact numbers: |  |

### Emergency Numbers

|           |  |
|-----------|--|
| Fire      |  |
| Ambulance |  |
| Hospital  |  |
| ATC       |  |
| Military  |  |





JCM Aerodesign Limited  
FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

Bell 206L, 206L-1, 206L-3 helicopters  
modified by installation of a survey modification  
in accordance with DoT Approval Number SH01-35.

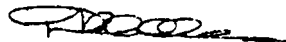
Sections 1 through 4 of this document comprise  
the Approved Flight Manual Supplement.  
Compliance with Section 1 - Limitations is mandatory.

Section 5 is Unapproved and is provided for  
information only.

The information and data contained in this document supersede  
or supplement that contained in the basic Approved Flight Manual  
in those areas listed herein. For Limitations,  
Procedures, and Performance not contained in this document refer  
to the Approved Flight Manual or any other Approved Flight  
Manual Supplements.

This Supplement is to be attached to the Approved Flight Manual  
for the aircraft with the subject design change incorporated.

Department of Transport (Canada) Approved:



D. Phillips  
Regional Airworthiness Engineer  
Ontario Region

JCM Aerodesign Limited  
FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

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| Emergency Procedures | 3.0            | 5           |
| Performance          | 4.0            | 5           |
| Unapproved Data      | 5.0            | 6           |

JCM Aerodesign Limited  
FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

**1. LIMITATIONS**

3.1 AIRSPEED With this modification incorporated:

Vne = 65 knots IAS  
Vne<sub>AUTO</sub> = 65 knots IAS

3.2 MAXIMUM WEIGHTS No change.

3.3 C of G LIMITS No change.

3.4 KINDS OF OPERATION With this modification incorporated the rotorcraft is intended for survey operation only. Due to the low range of speeds approved for this modification wherever possible the system should be installed on site and ferry flights should be minimized.

3.5 MINIMUM CREW One pilot.

3.6 MAXIMUM OCCUPANTS Two, one pilot, one equipment operator.

3.7 FLIGHT RESTRICTIONS The rotorcraft is restricted to day VFR only when this modification is incorporated. The equipment operator must occupy a rear seat.

3.8 PLACARDS The booms must be placarded "NO PUSH" in prominent locations.

3.9 APPROVED CONFIGURATIONS The forward (lateral) boom must have gimbals and sensors installed as otherwise the boom exhibits objectionable vibration characteristics.

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FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

**2. NORMAL PROCEDURES**

- 2.1 PRE-FLIGHT In all flight configurations when the system is installed, ballast will be required in the aft baggage compartment to keep the c.g. within the approved envelope.
- 2.2 FIRST-FLIGHT On initial installation, the first flight should be used to check that the rotor low-pitch stops provide an acceptable rotor rpm under autorotative descent under the ambient atmospheric conditions and operational weight.
- 2.3 TAKEOFF AND HOVER This modification has little effect on takeoff and hover performance, however it does slow the response to control inputs.
- 2.4 FORWARD FLIGHT In powered forward flight the stick position vs speed curve becomes negative at higher speeds, and the helicopter exhibits a tendency to pitch down in response to gusts. These characteristics are accompanied by a general pitch sensitivity that requires smooth control inputs to avoid pilot induced oscillations.
- 2.5 AUTOROTATION Power reductions are accompanied by a slight pitch up tendency that is easily controlled. The stick position vs speed curve becomes negative at low speeds. Autorotative descents should be performed at 60 - 65 knots. Installation of this modification may result in a slight reduction in the rotor rpm in autorotation which is why this should be checked on the first flight.

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FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

**3. EMERGENCY PROCEDURES**

- 3.1 EXCESSIVE VIBRATION If excessive vibration is experienced at any time reduce speed to minimize aerodynamic excitation forces and land as soon as practical.

**4. PERFORMANCE**

Because this system is intended for low level operations only the effect on climb and cruise performance has not been determined. The modification results in an increase in torque required for hovering of approximately 5% from the flight manual values.

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FLIGHT MANUAL SUPPLEMENT  
No. 003045FMS

3 UNAPPROVED DATA



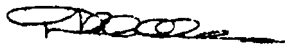
JCM Aerodesign Limited  
Instructions For Continued Airworthiness  
No. 003045ICA

Bell 206L, 206L-1, 206L-3 helicopters  
modified by installation of a survey modification  
in accordance with DoT Approval Number SH01-35.

The information and data contained in this document supersede or supplement that contained in the basic Maintenance Manual in those areas listed herein. For procedures not contained in this document refer to the Approved Maintenance Manual or any other Approved Maintenance Manual Supplements.

This Supplement is to be attached to the Approved Maintenance Manual for the aircraft with the subject design change incorporated.

Department of Transport (Canada) Approved:



D. Phillips  
Regional Airworthiness Engineer  
Ontario Region



JCM Aerodesign Limited  
Instructions For Continued Airworthiness  
No. 003045ICA

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| Daily Inspection               | 3.0            | 6           |
| Abnormal Occurrence Inspection | 4.0            | 7           |
| Weight and Balance             | 5.0            | 9           |
| Required Placards              | 6.0            | 10          |

JCM Aerodesign Limited  
Instructions For Continued Airworthiness  
No. 003045ICA

1. DESCRIPTION



GENERAL: The survey modification addressed in this document consists of an assembly of composite tubes secured to the helicopter by means of aluminum brackets. An array of seven magnetometers is contained on gimbals in the forward lateral tube, and preamplifiers are attached to brackets in the forward tubes.

This system is intended for low level, low speed survey use. The system must be operated in accordance with Flight Manual Supplement 003045FMS.

**INSTALLATION AND REMOVAL OF THIS SYSTEM DOES NOT QUALIFY AS ELEMENTARY MAINTENANCE AND MUST BE PERFORMED BY AN APPROPRIATELY RATED TECHNICIAN. EACH INSTALLATION AND REMOVAL MUST BE ACCOMPANIED BY A MAINTENANCE RELEASE.**

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Instructions For Continued Airworthiness  
No. 003045ICA

## 2. INSTALLATION PROCEDURES

INITIAL INSTALLATION: The initial installation of this system is addressed in installation drawing JCM-003045. During the initial installation of this system on a specific rotorcraft the weight and balance report must be amended to show the installation as an optional configuration. Due to the very long moment arms, small weight changes in the array have a large impact on the longitudinal center of gravity of the aircraft. For this reason it is important to establish the actual weight and balance point of the array prior to installation. The moment arm for the entire array can be calculated knowing that the forward cross tube is at station 73. The balance point of the array will typically be forward of the aircraft datum, and thus the moment arm for the array will be negative. Note that the maximum permitted weight and forward cg location of the tubes, sensors, preamps and associated mounting structure is indicated in section 5 of this document. The actual weight and cg of the complete tube assembly may be determined by weighing and measuring individual components, or by fully assembling the unit on the ground, weighing it, and finding its balance point.

SUBSEQUENT INSTALLATION: If the system is removed for ferry flight purposes, and will be reinstalled in the field, the cross tube cradle fittings and the rear tube attach fitting installed as part of the modification may be left in place, and only the tubes removed. This will make subsequent field installation much easier.

ELECTRICAL CONNECTIONS: This system obtains power from the existing rotorcraft utility circuit. The installer is responsible for ensuring that the electrical connection is secure and any cables are appropriately secured.

ANTENNAE: Installation of this modification may require removal of belly mounted antennae that may conflict with the installation. Any equipment rendered inoperative by such action must be placarded as "UNSERVICEABLE".

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Instructions For Continued Airworthiness  
No. 003045ICA

BALLAST: The installer is cautioned that this modification will require removal of fixed nose ballast (if installed) and may require installation of fixed tail ballast. On subsequent installations, the installer must ensure that the actual ballast configuration matches that shown on the original weight and balance report. It may be necessary to adjust the ballast configuration or to move weight installed in the baggage compartment when the system is removed for ferry flights.

SLIP JOINTS: The tubes which form the structure are assembled by means of slip joints, secured with multiple 10-32 machine screws. The machine screws reduce the relative motion with in a joint by providing clamping pressure as opposed to by acting in shear. For the screws to act properly they must be tightened firmly. It is not necessary to use a torque wrench, in assembling the slip joints; however, a torque of 12 to 15 inch points is recommended.

In any slip joint not more than two screws may be defective without affecting joint security. All defective fasteners should be repaired or replaced at the next opportunity.

Non-magnetic machine screws and nutplates are required at all slip joints to prevent interference with the survey sensors. If machine screws or nutplates require replacement use the following part numbers (or equivalent):

Machine screw p/n MS51958-64  
Nutplate p/n MS21060-3

BOLTED ATTACHMENTS: Bolts installed as part of this installation should be torqued as follows:

|                  |                  |
|------------------|------------------|
| 1/4-28 UNF Nuts  | 50 - 70 in.lb.   |
| 5/16-24 UNF Nuts | 100 - 140 in.lb. |

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**3. DAILY INSPECTION**

A "Daily Inspection" must be performed prior to the first flight of each day, and after each installation.

| Item | Area to be Inspected                               | Inspection Action                                 | Initial |
|------|--|---|---------|
| 1    | Main airframe attach bolts and nuts.               | Visual inspection for security.                   |         |
| 2    | Slip joints.                                       | All fasteners tight, no relative motion in joint. |         |
| 3    | Forward tube attach rings (at forward cross tube). | Fasteners tight and wire locked.                  |         |
| 4    | Aft tube attach brackets (at hoist attach point).  | Fasteners tight, split pins secure.               |         |
| 5    | Electrical harness.                                | Visual inspection for security.                   |         |
| 6    | Laser Altimeter brackets (at aft cross tube).      | Fasteners tight and wire locked.                  |         |
| 7    | Tubes  | Visual for cracks, worn holes or other damage.    |         |
| 8    | Fixed Ballast                                      | Visual for security and correct configuration.    |         |
| 9    | Baggage (removable ballast)                        | Visual for security and correct configuration.    |         |

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**4. ABNORMAL OCCURANCE INSPECTION**

An "Abnormal Occurrence Inspection" must be performed in the event of a heavy landing, a ground strike, or report of excessive in-flight vibration.

| Item | Area to be Inspected                       | Inspection Action  | Initial |
|------|--|--|---------|
| 1    | Main airframe attach points.               | Visual inspection for damage to the airframe and the cross tube attach fittings. If any denting or deformation of the belly panels is detected, remove the landing gear and inspect fully. |         |
| 2    | Tubes and slip joints internal inspection. | Visual for damage. "Coin Tap" any areas of suspected delamination. No delamination of tubes is permitted except minor damage limited to the first 1/2" from the end of the tubes.          |         |
| 3    | Gimbals and Preamp platforms.              | Check for security and for damaged gimbals and preamp platforms. Replace if required.  |         |

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|   |                                  |   |  |
|---|----------------------------------|---|--|
| 4 | Slip joint screws and nutplates. | Check holes for elongation, screws and nutplates for security. Replace any defective screws or nutplates. Tubes with holes elongated due to impact damage must be replaced. |  |
| 5 | Daily Inspection.                | Perform a "Daily Inspection" before releasing the aircraft for service.   |  |

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**5. WEIGHT AND BALANCE**

The following typical weights are provided for reference only.  
USE ACTUAL MEASURED WEIGHTS AND ARMS.

| ITEM  | Qty | Total Weight (lbs) | Arm (in aft of datum)              | Moment (in.lbs) |
|---|-----|--------------------|------------------------------------|-----------------|
| Lateral tube assembly with gimbals, end caps and magnetometers                              | 1   | 40                 | -111                               | -4440           |
| Forward tubes   | 2   | 30                 | -50.12                             | -1504           |
| Root tube (with forks)  | 2   | 60                 | 76.25                              | 4575            |
| Preamp platforms with preamplifiers (fwd)   | 2   | 10                 | -63.5                              | -635            |
| Preamp Platforms with preamplifiers (aft)   | 2   | 12                 | -10.75                             | -129            |
| Fwd tube brackets (with hoops)  | 1   | 16                 | 70.5                               | 1128            |
| Aft tube bracket  | 1   | 3                  | 121                                | 363             |
| <b>THE SUM OF ITEMS LISTED ABOVE MUST NOT EXCEED THE FOLLOWING WEIGHT AND MOMENT VALUES</b> |     | <b>180 (MAX)</b>   | <b>-13.00 (MAXIMUM FORWARD CG)</b> |                 |
| Laser/Radar altimeter and bracket   | 1   | 27                 | 167                                | 4509            |
| Equipment rack  | 1   | 200 max            | 129                                |                 |

Note: The empty weight and balance may lie outside the normal empty weight and balance limits for the rotorcraft. Accordingly, the installer must ensure that the operational configuration lies within the operational flight limits. The following should be considered:

- 1) Only the pilot may occupy a front seat.
- 2) The equipment operator must occupy a rear seat, but flight without an equipment operator should be considered also.
- 3) No other passengers are permitted.
- 4) Fixed nose ballast must be removed.



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- 5) Fixed tail ballast may be required.
- 6) Removable ballast will be required in the baggage compartment.
- 7) Both full fuel and minimum fuel conditions should be considered.
- 8) The system must be balanced laterally.
- 9) Flight without sensors installed in the tubes is not permitted as it results in unacceptable vibrations.

**6. REQUIRED PLACARDS**

The rotorcraft must not be moved by pushing or pulling on the survey installation. Accordingly the following means are required to alert personnel.

All Tubes - Placard "NO PUSH"  
End Caps - must be painted RED or YELLOW

The equipment rack installed in the cabin must be placarded as follows:

"MAX WEIGHT 200 LB", and  
"MAXIMUM C. OF G. HEIGHT OF EQUIPMENT RACK  
NOT TO EXCEED 14 INCHES"

### General Notes

- 1) These notes form part of the drawing and apply unless specifically changed elsewhere on this drawing.
- 2) Report all errors, omissions, and anomalies to the JCM Aerodesign.
- 3) Workmanship to be in accordance with FAA AC43.13-1B and - 2A as applicable.

### Applicability

This modification is applicable to Bell 206L series helicopters equipped with provisions for a lifting hook, and high skid gear only.

### Specific Notes

- 1) Placard equipment rack pallet:  
"MAX WEIGHT 200 LB".  
"MAXIMUM C. OF G. HEIGHT OF EQUIPMENT RACK NOT TO EXCEED 14 INCHES".
- 2) The installer is responsible for determining the weight and moment changes.

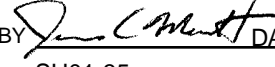
|                    |    |     |     |     |     |   |   |   |   |   |    |
|--------------------|----|-----|-----|-----|-----|---|---|---|---|---|----|
| Sheet Number       | 1  | 2-1 | 2-2 | 2-3 | 2-4 | 3 | 4 | 5 | 6 | 7 | 8  |
| Effective Revision | D  | B   | B   | nc  | A   | D | B | B | A | B | nc |
| Sheet Number       | 9  | 10  | 11  | 12  |     |   |   |   |   |   |    |
| Effective Revision | nc | nc  | nc  | A   |     |   |   |   |   |   |    |

This document  
is approved only  
when dated and  
signed.

**CANADA**  
DEPARTMENT OF TRANSPORT  
AERONAUTICAL ENGINEERING  
DIVISION

May 22, 2001

**APPROVED**

BY  DAR 205  
No. SH01-35 Issue 1

|    |          |     |     |   |
|----|----------|-----|-----|---|
|    |          |     |     |   |
|    |          |     |     |   |
|    |          |     |     |   |
|    |          |     |     |   |
| D  | 01.05.22 | RJS | JCM | Las/Rad altimeter added                   |
| C  | 01.03.20 | RJS | JCM | Equipment pallet added.                   |
| B  | 01.02.26 | RJS | JCM | Fw'd attach rev. Gimbals & platform added |
| A  | 01.02.05 | RJS | JCM | Fw'd attachment revised.                  |
| nc | 01.01.16 | RJS | JCM | Original Issue                            |

|      |      |       |         |
|------|------|-------|---------|
| Rev. | Date | Drawn | Checked |
|------|------|-------|---------|

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Limited**


P.O. Box 415 Peterborough, Ontario  
Canada K9J 6Z3

TITLE Survey  
Modification

DWG. NO.  
JCM-003045

|       |     |
|-------|-----|
| SHEET | REV |
| 1     | D   |

| Quantity per Assembly |  |  |  |     |    |    |    |   |   | Item | ASM | Description             | PN or Material | Material Size | Specification | see<br>sht |
|-----------------------|--|--|--|-----|----|----|----|---|---|------|-----|-------------------------|----------------|---------------|---------------|------------|
|                       |  |  |  | 107 | 71 | 17 | 12 | 3 | 1 |      |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 1    | x   | Lateral Mag Array Inst. |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 2    |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 3    | x   | Boom Assy.              | 003045-00      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 4    |     | Root Tube               | 003045-01      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 5    |     | Tip Tube                | 003045-02      |               |               |            |
|                       |  |  |  |     |    |    |    | 1 |   | 6    |     | Cross Tube - Center     | 003045-03      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 7    |     | Slip Joint              | 003045-04      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 8    |     | Cross Tube - Outb'd     | 003045-05      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 9    |     | End Cap - Ø10.75"       | 003045-06      |               |               |            |
|                       |  |  |  |     |    |    |    | 2 |   | 10   |     | End Cap - Ø8.5"         | 003045-07      |               |               |            |
|                       |  |  |  |     |    |    |    | 5 |   | 11   |     | Cover Plate             | 003045-08      |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 12   | x   | Forward Support Assy.   |                |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 13   |     | Hoop - Side             | 003045-10      |               |               |            |
|                       |  |  |  |     |    |    | 1  |   |   | 14   |     | Beam                    | 003045-11      |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 15   |     | Saddle - Forward        | 003045-12      |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 16   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 17   | x   | Aft Support Assy.       |                |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 18   |     | Ring                    | 003045-20      |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 19   |     | Saddle Bearing          | 003045-21      |               |               |            |
|                       |  |  |  |     |    |    | 1  |   |   | 20   |     | Beam                    | 003045-22      |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 21   |     | Pin Assy.               | 003045-23      |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 22   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    | 2  |   |   | 23   |     | Rubber                  | 003045-24      |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 24   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 25   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 7 | 26   |     | Gimbal                  | AG850          |               |               |            |
|                       |  |  |  |     |    |    |    |   | 4 | 27   |     | Platform Assy.          | AP10750        |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 28   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 29   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 30   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 31   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 32   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 33   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 34   |     |                         |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 35   |     |                         |                |               |               |            |

|                        |  |  |  |  |  |  |  |  |  |            |  |  |  |  |  |  |  |  |  |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |                           |  |  |  |  |  |  |  |  |  |
|------------------------|--|--|--|--|--|--|--|--|--|------------|--|--|--|--|--|--|--|--|--|----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---------------------------|--|--|--|--|--|--|--|--|--|
| DRAWN<br>RJS           |  |  |  |  |  |  |  |  |  | CHECKED    |  |  |  |  |  |  |  |  |  | APPROVED |  |  |  |  |  |  |  |  |  | <div>JCM<br/>Aerodesign<br/>Limited</div> |  |  |  |  |  |  |  |  |  | TITLE Survey Modification |  |  |  |  |  |  |  |  |  |
| DWG. NO.<br>JCM-003045 |  |  |  |  |  |  |  |  |  | SHT<br>2-1 |  |  |  |  |  |  |  |  |  | REV<br>B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |                           |  |  |  |  |  |  |  |  |  |

| Quantity per Assembly |  |  |  |     |    |    |    |    |    | Item | ASM | Description   | PN or Material | Material Size | Specification | see<br>sht |
|-----------------------|--|--|--|-----|----|----|----|----|----|------|-----|---------------|----------------|---------------|---------------|------------|
|                       |  |  |  | 107 | 71 | 17 | 12 | 3  | 1  |      |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    |    |    |      |     |               |                |               |               |            |
|                       |  |  |  |     |    | 8  |    |    |    | 36   |     | Bolt          | AN3-5A         |               |               |            |
|                       |  |  |  |     |    | 8  |    |    |    | 37   |     | Bolt          | AN4-12A        |               |               |            |
|                       |  |  |  |     |    | 4  |    |    |    | 38   |     | Bolt          | AN4-12A        |               |               |            |
|                       |  |  |  |     |    |    | 4  |    |    | 39   |     | Bolt          | AN4-22A        |               |               |            |
|                       |  |  |  |     |    |    | 4  |    |    | 40   |     | Bolt          | AN4-26A        |               |               |            |
|                       |  |  |  |     |    | 4  |    |    |    | 41   |     | Bolt          | AN5-14A        |               |               |            |
|                       |  |  |  |     |    |    | 2  |    |    | 42   |     | Bolt          | Grade 8        | 3/8-24 X 6"   | Spae Naur     |            |
|                       |  |  |  |     |    |    | 4  |    |    | 43   |     | Machine Screw | AN502-10-14    |               |               |            |
|                       |  |  |  |     |    |    |    |    | 88 | 44   |     | Machine Screw | MS51958-64     |               |               |            |
|                       |  |  |  |     |    |    |    |    | 88 | 45   |     | Nutplate      | MS21060-3      |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 46   |     |               |                |               |               |            |
|                       |  |  |  |     |    | 4  | 4  |    |    | 47   |     | Nut           | MS21042-4      |               |               |            |
|                       |  |  |  |     |    | 8  |    |    |    | 48   |     | Nut           | MS21044N3      |               |               |            |
|                       |  |  |  |     |    | 8  | 4  |    |    | 49   |     | Nut           | MS21044N4      |               |               |            |
|                       |  |  |  |     |    | 4  |    |    |    | 50   |     | Nut           | MS21044N5      |               |               |            |
|                       |  |  |  |     |    |    | 2  |    |    | 51   |     | Nut           | MS21083-6      |               |               |            |
|                       |  |  |  |     |    | 2  |    |    |    | 52   |     | Nut, castle   | AN310-10       |               |               |            |
|                       |  |  |  |     |    | 16 |    |    |    | 53   |     | Washer        | AN960-10L      |               |               |            |
|                       |  |  |  |     |    | 16 | 8  |    |    | 54   |     | Washer        | AN960-416      |               |               |            |
|                       |  |  |  |     |    |    |    |    | ar | 55   |     | Washer        | AN960-416L     |               |               |            |
|                       |  |  |  |     |    | 8  |    |    |    | 56   |     | Washer        | AN960-516      |               |               |            |
|                       |  |  |  |     |    |    | 2  |    |    | 57   |     | Washer        | AN960-616      |               |               |            |
|                       |  |  |  |     |    | 2  |    |    |    | 58   |     | Washer        | AN960-1016     |               |               |            |
|                       |  |  |  |     |    | 2  |    |    |    | 59   |     | Washer        | AN960-1616     |               |               |            |
|                       |  |  |  |     |    | 2  |    |    |    | 60   |     | Cotter Pin    | MS24665-285    |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 61   |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    | 60 |    | 62   |     | Screw, Nylon  | 374-011        | 1/4-20 x 3/4  | Spae-Naur     |            |
|                       |  |  |  |     |    |    |    | 16 |    | 63   |     | Screw, Nylon  | 374-005        | 8-32 x 1/2"   | Spae-Naur     |            |
|                       |  |  |  |     |    |    |    |    |    | 12   |     | Machine Screw | MS51958-64     |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 12   |     | Nutplate      | MS21060-3      |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 66   |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 67   |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 68   |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 69   |     |               |                |               |               |            |
|                       |  |  |  |     |    |    |    |    |    | 70   |     |               |                |               |               |            |

# BILL OF MATERIALS

DRAWN  
RJS

CHECKED

APPROVED



**JCM**  
**Aerodesign**  
**Limited**

TITLE Survey Modification

DWG. NO.  
JCM-003045

SHT  
2-2

REV  
B

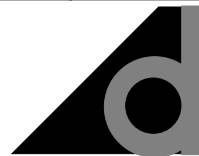
| Quantity per Assembly |  |  |  |     |    |    |    |   |   | Item | ASM | Description           | PN or Material | Material Size | Specification | see<br>sht |
|-----------------------|--|--|--|-----|----|----|----|---|---|------|-----|-----------------------|----------------|---------------|---------------|------------|
|                       |  |  |  | 107 | 71 | 17 | 12 | 3 | 1 |      |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 71   | x   | Equipment Rack Pallet |                |               |               |            |
|                       |  |  |  |     | 1  |    |    |   |   | 72   |     | Pallet                | 003045-42      |               |               |            |
|                       |  |  |  |     | 1  |    |    |   |   | 73   |     | Fitting               | 003045-41      |               |               |            |
|                       |  |  |  |     | 1  |    |    |   |   | 74   |     | Fitting               | 003045-44      |               |               |            |
|                       |  |  |  |     | 1  |    |    |   |   | 75   |     | Bracket               | 003045-45      |               |               |            |
|                       |  |  |  |     | 1  |    |    |   |   | 76   |     | Equipment Rack        | GA012048-1     |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 77   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 78   |     |                       |                |               |               |            |
|                       |  |  |  |     | 3  |    |    |   |   | 79   |     | Bolt                  | AN3-4A         |               |               |            |
|                       |  |  |  |     | 4  |    |    |   |   | 80   |     | Bolt                  | AN4-12A        |               |               |            |
|                       |  |  |  |     | 2  |    |    |   |   | 81   |     | Bolt                  | AN4-14A        |               |               |            |
|                       |  |  |  |     | 2  |    |    |   |   | 82   |     | Screw                 | AN525-10R12    |               |               |            |
|                       |  |  |  |     | 4  |    |    |   |   | 83   |     | Screw                 | AN525-10R14    |               |               |            |
|                       |  |  |  |     | ar |    |    |   |   | 84   |     | Washer                | AN960-10       |               |               |            |
|                       |  |  |  |     | ar |    |    |   |   | 85   |     | Washer                | AN960-416      |               |               |            |
|                       |  |  |  |     | 6  |    |    |   |   | 86   |     | Nut                   | MS21044N3      |               |               |            |
|                       |  |  |  |     | 2  |    |    |   |   | 87   |     | Nut                   | MS21044N4      |               |               |            |
|                       |  |  |  |     | 6  |    |    |   |   | 89   |     | Washer                | AN970-3        |               |               |            |
|                       |  |  |  |     | 16 |    |    |   |   | 90   |     | Washer                | AN970-4        |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 91   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 92   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 93   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 94   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 95   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 96   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 97   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 98   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 99   |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 100  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 101  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 102  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 103  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 104  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 105  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 106  |     |                       |                |               |               |            |

# BILL OF MATERIALS

DRAWN  
RJS

CHECKED

APPROVED



**JCM  
Aerodesign  
Limited**

|       |                     |
|-------|---------------------|
| TITLE | Survey Modification |
|-------|---------------------|

DWG. NO.  
JCM-003045

|            |           |
|------------|-----------|
| SHT<br>2-3 | REV<br>nc |
|------------|-----------|

| Quantity per Assembly |  |  |  |     |    |    |    |   |   | Item | ASM | Description           | PN or Material | Material Size | Specification | see<br>sht |
|-----------------------|--|--|--|-----|----|----|----|---|---|------|-----|-----------------------|----------------|---------------|---------------|------------|
|                       |  |  |  | 107 | 71 | 17 | 12 | 3 | 1 |      |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   | 1 | 107  | x   | Las-Alt Inst.         |                |               |               |            |
|                       |  |  |  | 1   |    |    |    |   |   | 108  |     | Mounting Plate        | 003045-61      |               |               |            |
|                       |  |  |  | 2   |    |    |    |   |   | 109  |     | Saddle                | 003045-52      |               |               |            |
|                       |  |  |  | 1   |    |    |    |   |   | 110  |     | Beam                  | 003045-53      |               |               |            |
|                       |  |  |  | 2   |    |    |    |   |   | 111  |     | Bracket               | 003045-54      |               |               |            |
|                       |  |  |  | 4   |    |    |    |   |   | 112  |     | Thumbscrew            | 003045-55      |               |               |            |
|                       |  |  |  | 1   |    |    |    |   |   | 113  |     | Laser-Altimeter       | 3100           |               | Optech        |            |
|                       |  |  |  | 2   |    |    |    |   |   | 114  |     | Brace                 | 003045-62      |               |               |            |
|                       |  |  |  | 6   |    |    |    |   |   | 115  |     | Screw, Fillister Head | AN502-10-8     |               |               |            |
|                       |  |  |  | 8   |    |    |    |   |   | 116  |     | Bolt                  | AN4-20A        |               |               |            |
|                       |  |  |  | 4   |    |    |    |   |   | 117  |     | Bolt                  | AN5-25A        |               |               |            |
|                       |  |  |  | 2   |    |    |    |   |   | 118  |     | Bolt                  | 003045-56      |               |               |            |
|                       |  |  |  | 8   |    |    |    |   |   | 119  |     | Nut                   | MS21044N4      |               |               |            |
|                       |  |  |  | 4   |    |    |    |   |   | 120  |     | Nut                   | MS21042L5      |               |               |            |
|                       |  |  |  | ar  |    |    |    |   |   | 121  |     | Washer                | AN960-10       |               |               |            |
|                       |  |  |  | ar  |    |    |    |   |   | 122  |     | Washer                | AN960-416      |               |               |            |
|                       |  |  |  | ar  |    |    |    |   |   | 123  |     | Washer                | AN960-416L     |               |               |            |
|                       |  |  |  | ar  |    |    |    |   |   | 124  |     | Washer                | AN960-516      |               |               |            |
|                       |  |  |  | 3   |    |    |    |   |   | 125  |     | Bolt                  | AN3-20A        |               |               |            |
|                       |  |  |  | 6   |    |    |    |   |   | 126  |     | Bolt                  | AN3-6A         |               |               |            |
|                       |  |  |  | 9   |    |    |    |   |   | 127  |     | Nut                   | MS21044N3      |               |               |            |
|                       |  |  |  | ar  |    |    |    |   |   | 128  |     | Washer                | AN960-10L      |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 129  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 130  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 131  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 132  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 133  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 134  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 135  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 136  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 137  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 138  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 139  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 140  |     |                       |                |               |               |            |
|                       |  |  |  |     |    |    |    |   |   | 141  |     |                       |                |               |               |            |

# BILL OF MATERIALS

DRAWN  
RJS

CHECKED

APPROVED



**JCM  
Aerodesign  
Limited**

|       |                     |
|-------|---------------------|
| TITLE | Survey Modification |
|-------|---------------------|

DWG. NO.  
JCM-003045

|     |
|-----|
| SHT |
| 2-4 |

REV  
A

### LATERAL MAG ARRAY GENERAL ARRANGEMENT

**Side View Dimensions and Callouts:**

- Callouts: 9, 5, 4, 6, 8, 10, B see sht 8
- Dimensions: -111", -63.50" (fwd platform) see sht 10, -10.75" (aft platform) see sht 10, .00" (Datum), 65" (Pilot), 129" (Operator & Rack), 186" (Baggage)
- Reference: see sht 9 E, see sht 9 C, see sht 9 D

**Top View Dimensions and Callouts:**

- Callouts: 26, 11, A, see sht 4
- Dimensions: 7 PL. EVENLY SPACED, 5 PL., Nominal Ø11", Nominal Ø9"
- Reference: SEE SHT 10 FOR INST. DETAILS

**Right Side View Dimensions and Callouts:**

- Callouts: 287" (FIXED) BALLAST - MAX 20 LBS)
- Reference: SEE SHT 11 FOR RACK DETAILS

**Legend:**

| Letter | Revision | Date     | Description                                  |
|--------|----------|----------|--|
| A      | RJS      | 01.02.05 | Fw'd attachment revised                      |
| B      | RJS      | 01.02.26 | Fw'd attach. rev. Platforms & gimbals added. |
| C      | RJS      | 01.03.20 | Equipment rack note added.                   |
| D      | RJS      | 01.05.22 | Radar/Laser altimeters added.                |

**Static Level and Projection:**

STATIC LEVEL

Third Angle Projection

**Drawn and Approved:**

DRAWN: RJS  
CHECKED: [Signature]  
APPROVED: [Signature]  
SCALE: [Blank]

**Model Information:**

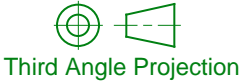
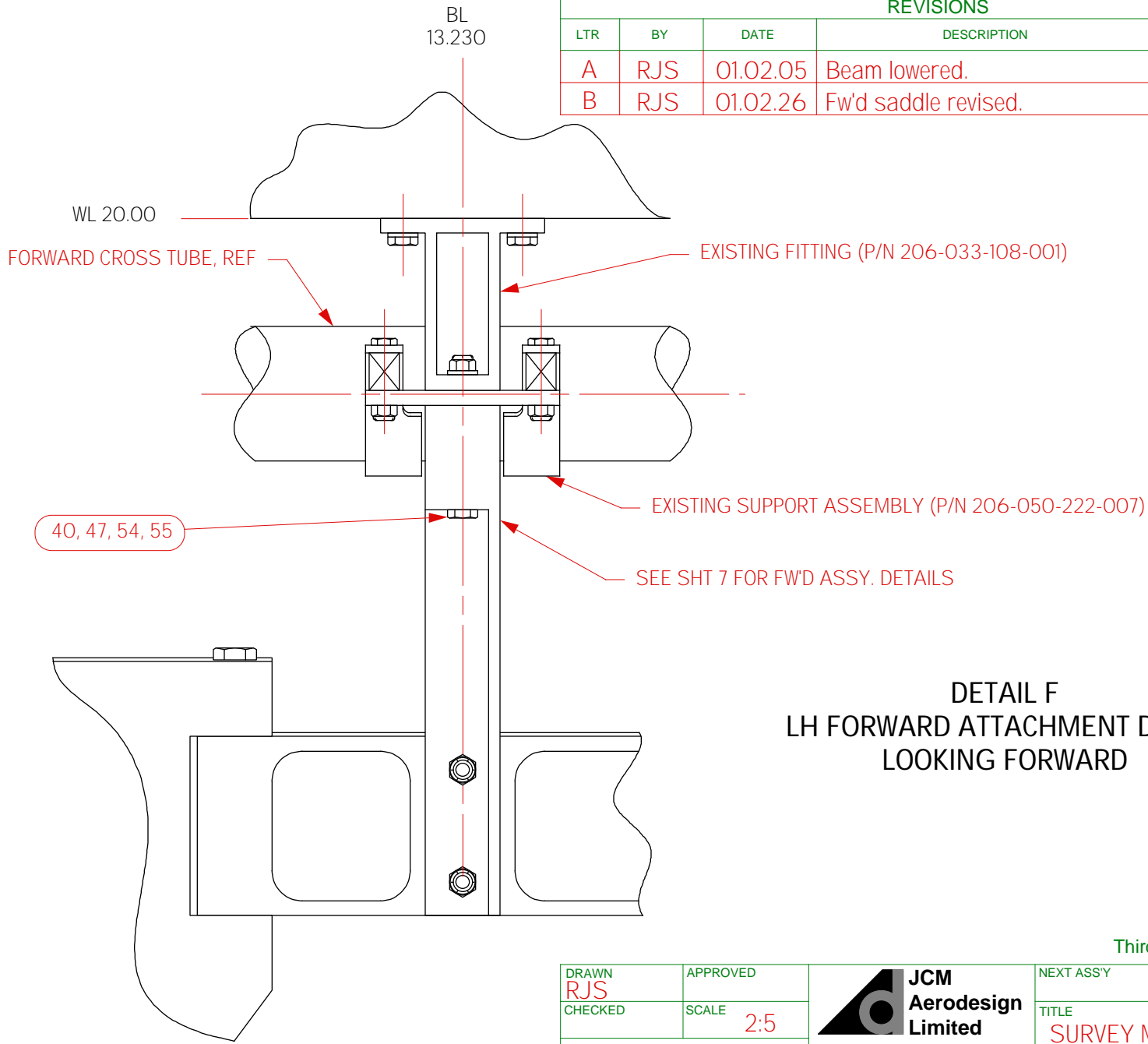
JCM Aerodesign  
NEXT ASSY: [Blank]  
MODEL: 206L  
TITLE: [Blank]

|   |                |  |                              |               |          |  |
|---|----------------|--|------------------------------|---------------|----------|--|
| DRAWN<br>RJS  | APPROVED       |  JCM<br>Aerodesign<br>Limited | NEXT ASS'Y                   | MODEL<br>206L |          |  |
| CHECKED   | SCALE<br>1:100 |  | TITLE<br>SURVEY MODIFICATION |               |          |  |
| This drawing contains information<br>proprietary to JCM Aerodesign Ltd. and<br>may only be used with the express written<br>permission of JCM Aerodesign Ltd. |                |  | DWG. NO.<br>JCM-003045       |               |          |  |
|   |                | P.O. Box 415<br>Peterborough, Ontario<br>Canada K9J 6Z3  |                              | SHEET<br>3    | REV<br>D |  |





| REVISIONS |     |          |                      |          |
|-----------|-----|----------|----------------------|----------|
| LTR       | BY  | DATE     | DESCRIPTION          | APPROVED |
| A         | RJS | 01.02.05 | Beam lowered.        |          |
| B         | RJS | 01.02.26 | Fw'd saddle revised. |          |

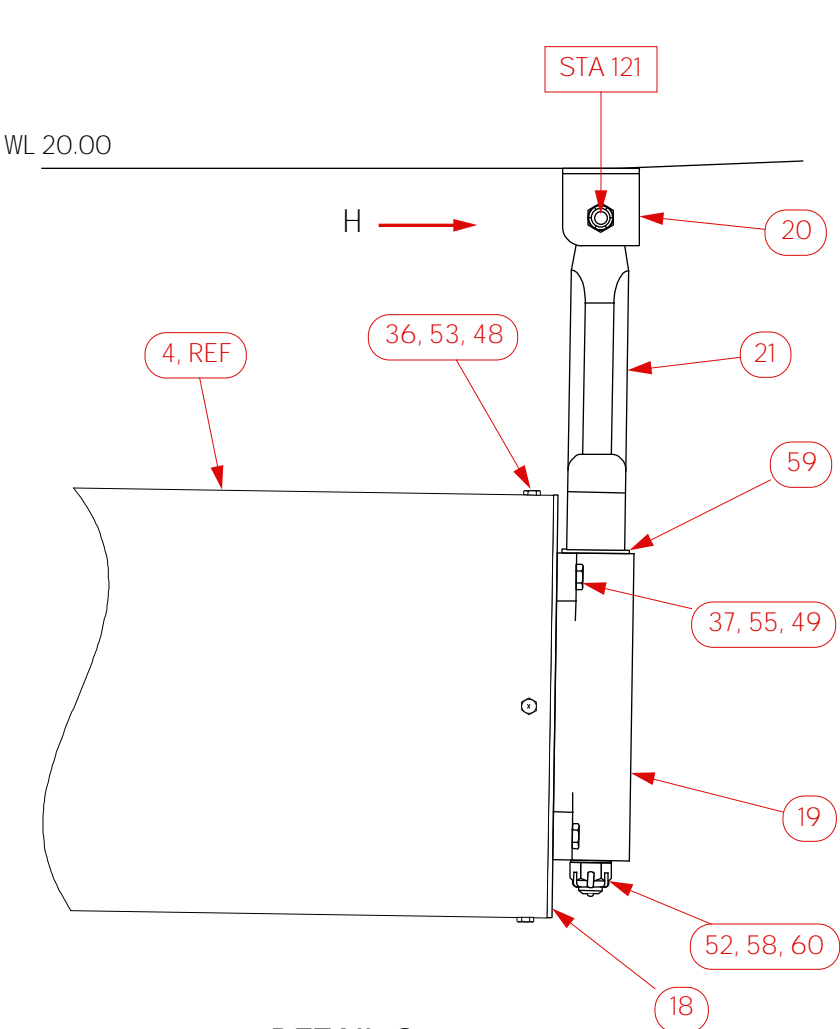


Third Angle Projection

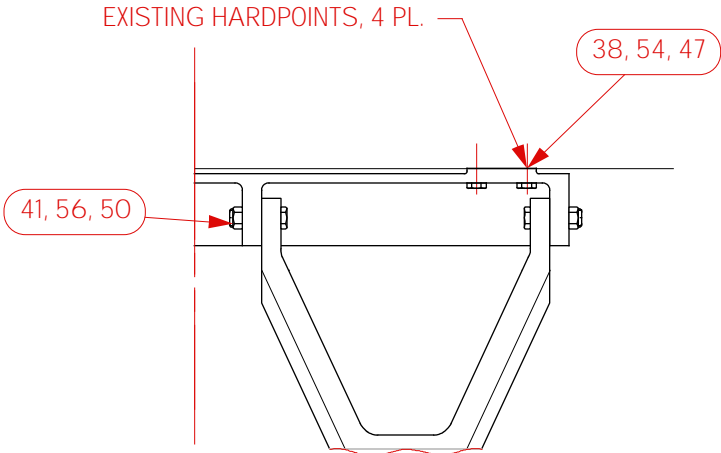
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|---|--------------|---|---|------------------------|------------|----------|
| DRAWN<br>RJS  | APPROVED     |  <b>JCM<br/>Aerodesign<br/>Limited</b> | NEXT ASS'Y  | MODEL<br>206L          |            |          |
| CHECKED   | SCALE<br>2:5 |   | TITLE<br>SURVEY MODIFICATION                            |                        |            |          |
| This drawing contains information<br>proprietary to JCM Aerodesign Ltd. and<br>may only be used with the express written<br>permission of JCM Aerodesign Ltd. |              |   | P.O. Box 415<br>Peterborough, Ontario<br>Canada K9J 6Z3 | DWG. NO.<br>JCM-003045 | SHEET<br>5 | REV<br>B |

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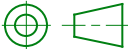
| REVISIONS |     |          |                     |          |
|-----------|-----|----------|---------------------|----------|
| LTR       | BY  | DATE     | DESCRIPTION         | APPROVED |
| A         | RJS | 01.02.05 | Tube angle changed. |          |



DETAIL G  
REAR ATTACHMENT INSTALLATION



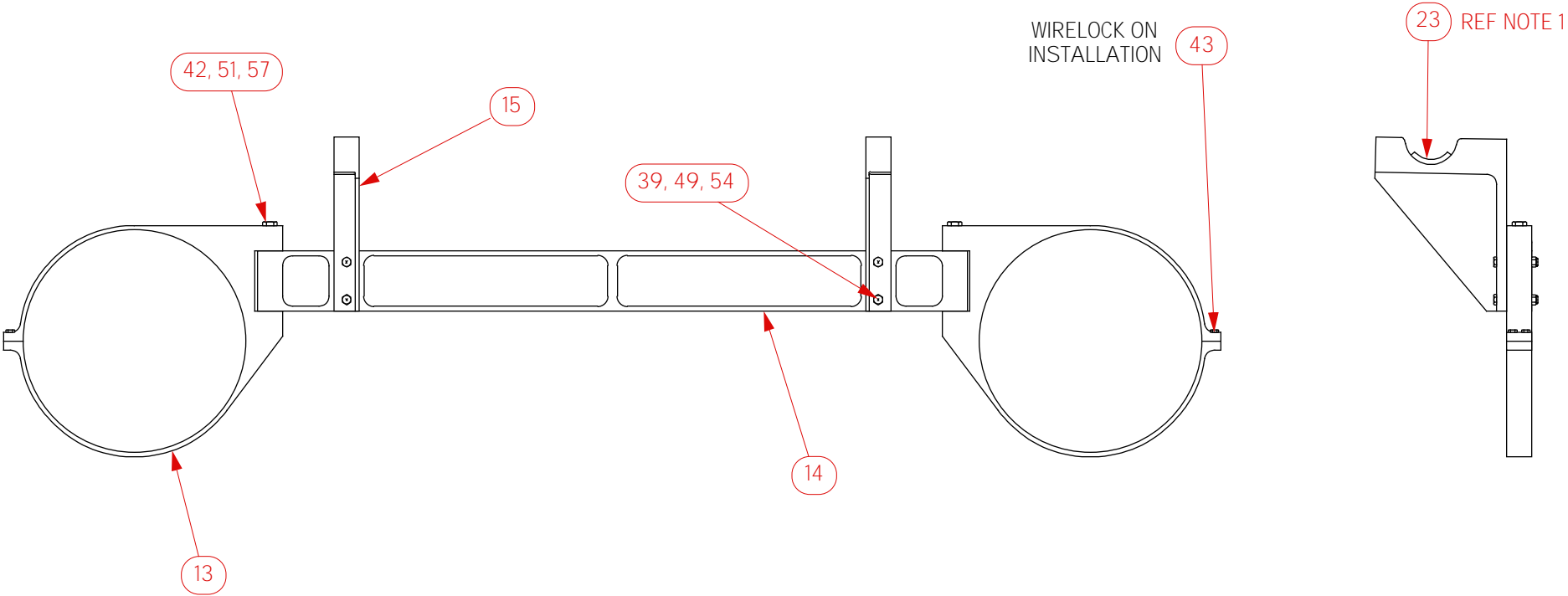
VIEW H

  
 Third Angle Projection

|   |              |   |                              |               |          |
|---|--------------|---|------------------------------|---------------|----------|
| DRAWN<br>RJS  | APPROVED     |  <b>JCM<br/>Aerodesign<br/>Limited</b> | NEXT ASS'Y                   | MODEL<br>206L |          |
| CHECKED   | SCALE<br>1:5 |   | TITLE<br>SURVEY MODIFICATION |               |          |
| This drawing contains information<br>proprietary to JCM Aerodesign Ltd. and<br>may only be used with the express written<br>permission of JCM Aerodesign Ltd. |              |   | DWG. NO.<br>JCM-003045       | SHEET<br>6    | REV<br>A |
| P.O. Box 415<br>Peterborough, Ontario<br>Canada K9J 6Z3   |              |   |                              |               |          |

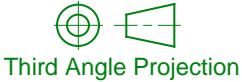
P.O. Box 415  
 Peterborough, Ontario  
 Canada K9J 6Z3

| REVISIONS |     |          |                                   |          |
|-----------|-----|----------|-----------------------------------|----------|
| LTR       | BY  | DATE     | DESCRIPTION                       | APPROVED |
| A         | RJS | 01.02.05 | Item 25 added.                    |          |
| B         | RJS | 01.02.26 | Item 25 removed. Item 15 revised. |          |



FORWARD ATTACHMENT  
ASSEMBLY

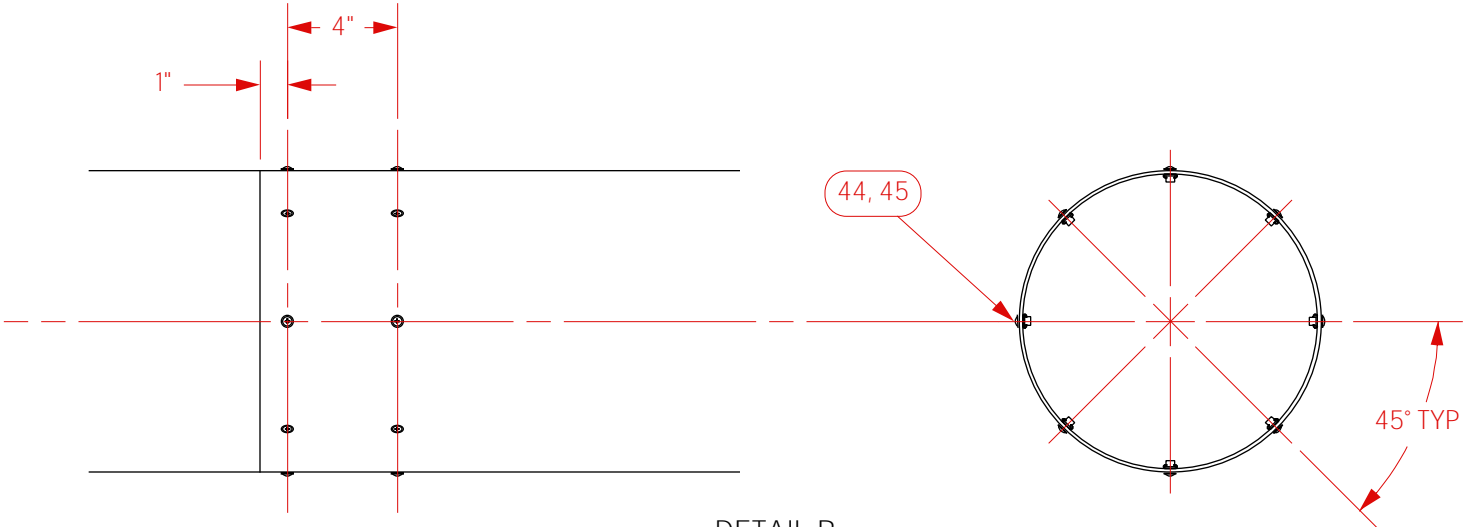
NOTES:  
1) ITEM 23 (RUBBER, 1/4" THICK) REQUIRED ON SURFACE OF SADDLE (ITEM 15)



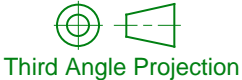
|   |              |   |   |                        |            |          |
|---|--------------|---|---|------------------------|------------|----------|
| DRAWN<br>RJS  | APPROVED     |  <b>JCM<br/>Aerodesign<br/>Limited</b> | NEXT ASS'Y  | MODEL<br>206L          |            |          |
| CHECKED   | SCALE<br>1:8 |   | TITLE<br>SURVEY MODIFICATION                            |                        |            |          |
| This drawing contains information<br>proprietary to JCM Aerodesign Ltd. and<br>may only be used with the express written<br>permission of JCM Aerodesign Ltd. |              |   | P.O. Box 415<br>Peterborough, Ontario<br>Canada K9J 6Z3 | DWG. NO.<br>JCM-003045 | SHEET<br>7 | REV<br>B |

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Peterborough, Ontario  
Canada K9J 6Z3

| REVISIONS |    |      |             |          |
|-----------|----|------|-------------|----------|
| LTR       | BY | DATE | DESCRIPTION | APPROVED |



DETAIL B  
(LONGITUDINAL TUBE SLIP JOINTS)



Third Angle Projection

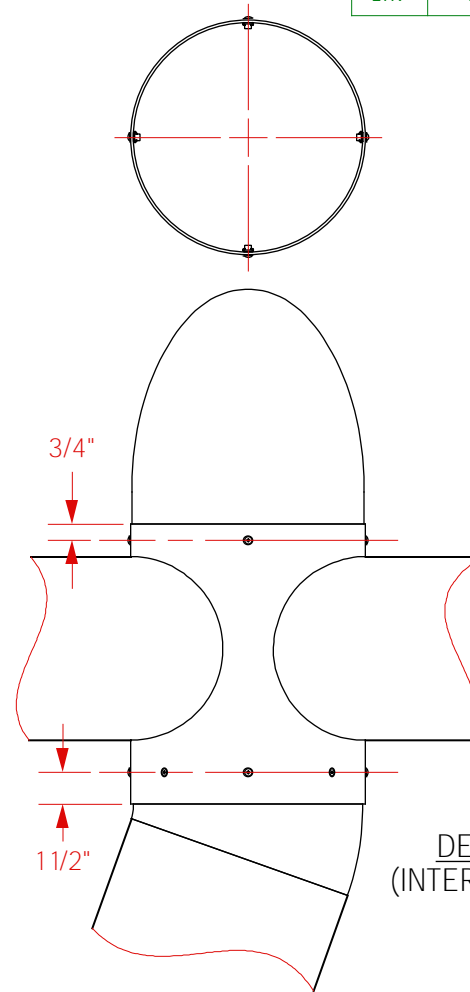
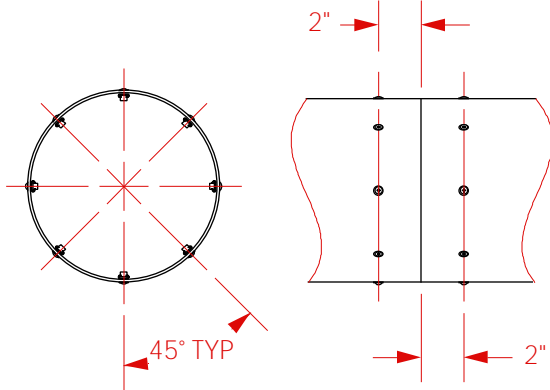
|   |              |   |   |                        |            |           |
|---|--------------|---|---|------------------------|------------|-----------|
| DRAWN<br>RJS  | APPROVED     |  <b>JCM<br/>Aerodesign<br/>Limited</b> | NEXT ASS'Y  | MODEL                  |            |           |
| CHECKED   | SCALE<br>1:7 |   | TITLE<br>SURVEY MODIFICATION                            |                        |            |           |
| This drawing contains information<br>proprietary to JCM Aerodesign Ltd. and<br>may only be used with the express written<br>permission of JCM Aerodesign Ltd. |              |   | P.O. Box 415<br>Peterborough, Ontario<br>Canada K9J 6Z3 | DWG. NO.<br>JCM-003045 | SHEET<br>8 | REV<br>NC |

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Canada K9J 6Z3

# REVISIONS

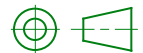
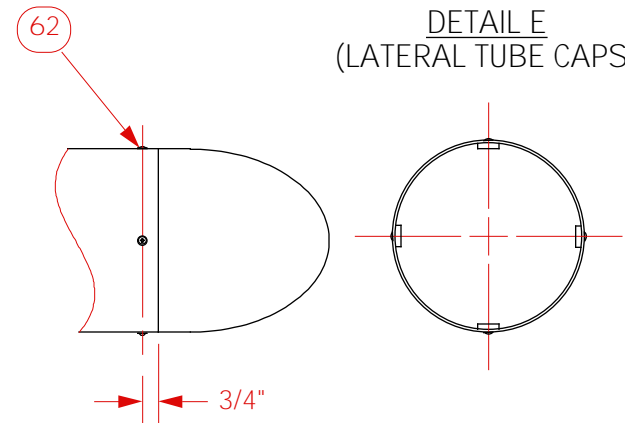
| LTR | BY | DATE | DESCRIPTION | APPROVED |
|-----|----|------|-------------|----------|
|-----|----|------|-------------|----------|

DETAIL C  
(LATERAL TUBE SLIP JOINTS)



DETAIL D  
(INTERSECTION)

DETAIL E  
(LATERAL TUBE CAPS)



Third Angle Projection

|  |                     |   |                                     |                               |                   |
|--|---------------------|---|-------------------------------------|-------------------------------|-------------------|
| DRAWN<br><b>RJS</b>  | APPROVED            |  <b>JCM Aerodesign Limited</b> | NEXT ASS'Y                          | MODEL                         |                   |
| CHECKED  | SCALE<br><b>1:7</b> |   | TITLE<br><b>SURVEY MODIFICATION</b> | DWG. NO.<br><b>JCM-003045</b> | SHEET<br><b>9</b> |
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| REVISIONS |    |      |             |          |
|-----------|----|------|-------------|----------|
| LTR       | BY | DATE | DESCRIPTION | APPROVED |

OPTIONAL GPS ANTENNA (TECO M)  
COVER OPENING WITH 003045-32 (COVER PLATE).  
ATTACH ANTENNA OR COVER WITH (8) 8-32 NYLON  
SCREWS (ITEM 63).

ANTENNA DETAIL

GIMBAL DETAIL

62, 4 PL./GIMBAL, EVENLY SPACED

PLATFORM DETAIL

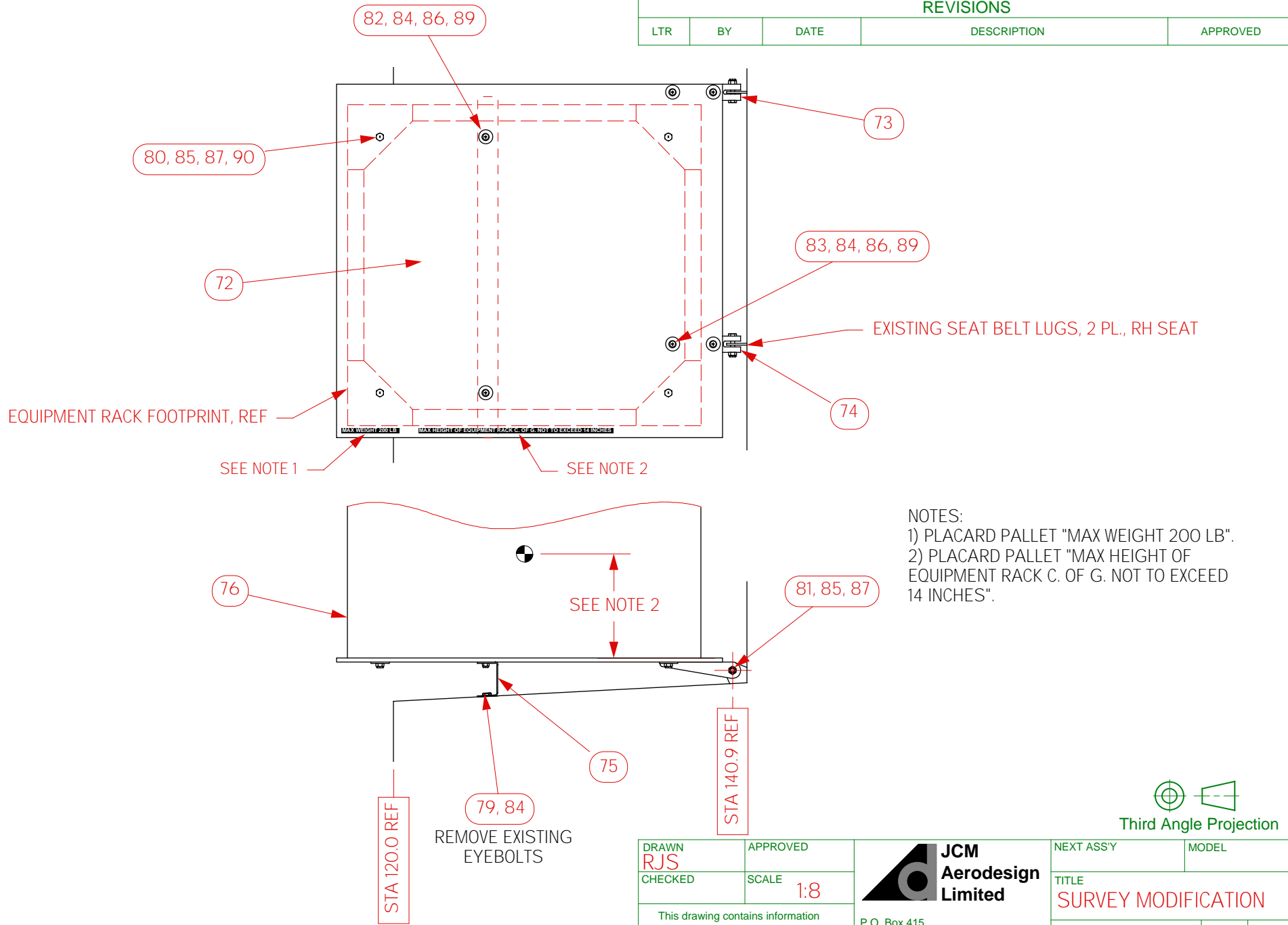
64, 65 (6 PL./PLATFORM)

Third Angle Projection

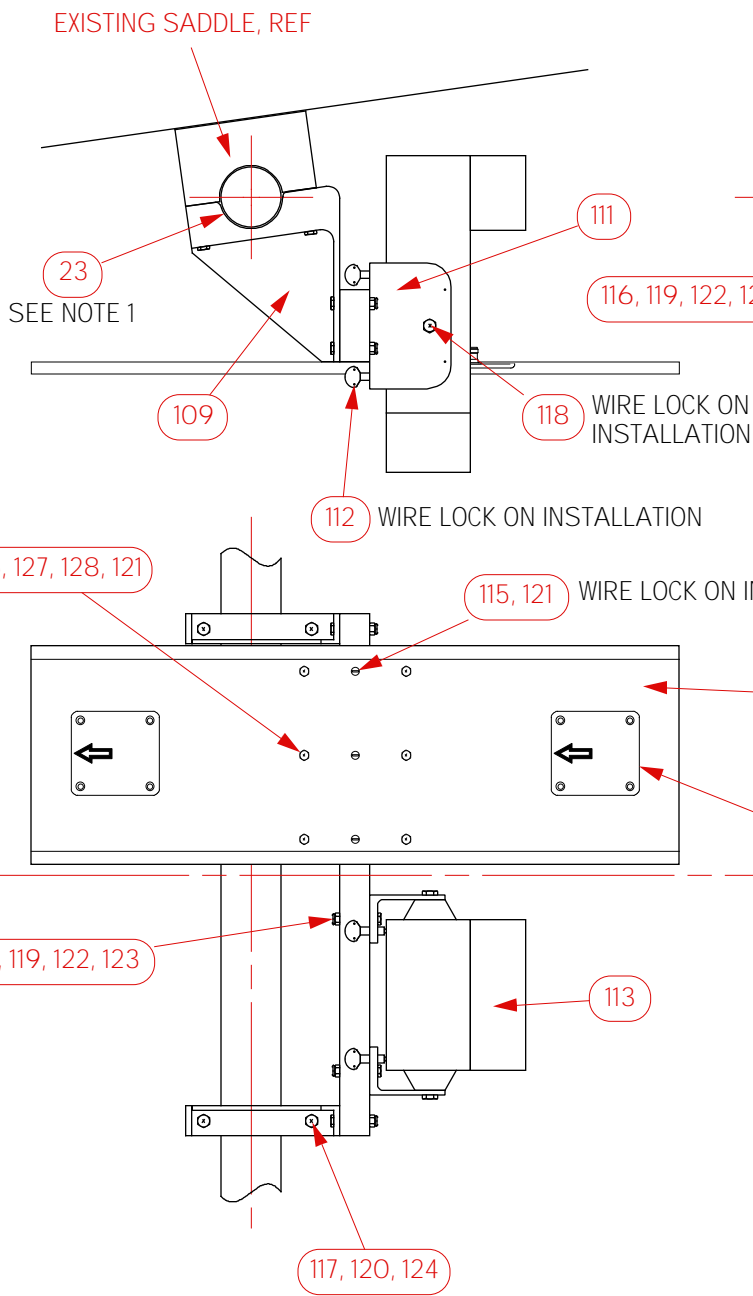
|   |              |   |   |                        |             |
|---|--------------|---|---|------------------------|-------------|
| DRAWN<br>RJS  | APPROVED     |  <div>JCM<br/>Aerodesign<br/>Limited</div> | NEXT ASS'Y  | MODEL                  |             |
| CHECKED   | SCALE<br>1:7 |   | TITLE<br>SURVEY MODIFICATION                            |                        |             |
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Canada K9J 6Z3

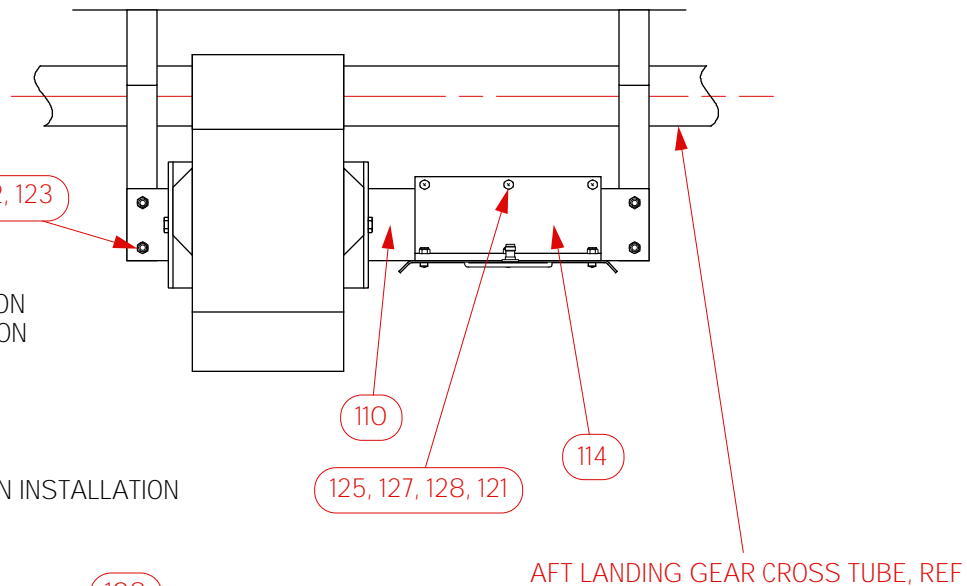
| REVISIONS |    |      |             |          |
|-----------|----|------|-------------|----------|
| LTR       | BY | DATE | DESCRIPTION | APPROVED |



|  |                     |   |                                     |                               |                    |
|--|---------------------|---|-------------------------------------|-------------------------------|--------------------|
| DRAWN<br><b>RJS</b>  | APPROVED            |  <b>JCM Aerodesign Limited</b> | NEXT ASS'Y                          | MODEL                         |                    |
| CHECKED  | SCALE<br><b>1:8</b> |   | TITLE<br><b>SURVEY MODIFICATION</b> | DWG. NO.<br><b>JCM-003045</b> | SHEET<br><b>11</b> |
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| REVISIONS |     |          |                          |          |
|-----------|-----|----------|--------------------------|----------|
| LTR       | BY  | DATE     | DESCRIPTION              | APPROVED |
| A         | JCM | 01.05.22 | radar altimeter modified |          |



ALTIMETER ANTENNA, REF  
SENSOR SYSTEMS  
S67-2002 SHOWN, REF

## AFT BEAM INSTALLATION

Third Angle Projection

NOTES:  
1) ITEM 23 (RUBBER, 1/4" THICK) REQUIRED ON SURFACE OF SADDLE (ITEM 15)

|   |                     |   |                                     |                                       |
|---|---------------------|---|-------------------------------------|---------------------------------------|
| DRAWN<br><b>RJS</b>   | APPROVED            |  <b>JCM<br/>Aerodesign<br/>Limited</b> | NEXT ASS'Y                          | MODEL                                 |
| CHECKED   | SCALE<br><b>1:8</b> |   | TITLE<br><b>SURVEY MODIFICATION</b> |                                       |
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Department of Transport

# Supplemental Type Certificate

**This approval is issued to:**

JCM Aerodesign Limited  
P.O. Box 415  
Peterborough, Ontario  
K9J 6Z3 Canada

**Number:** SH01-35

**Issue No.:** 1

**Approval Date:** May 24, 2001

**Issue Date:** June 8, 2001

**Responsible Office:**

Ontario

**Aircraft/Engine Type or Model:**

Bell 206L, 206L-1, 206L-3

**Canadian Type Certificate or Equivalent:**

H-92

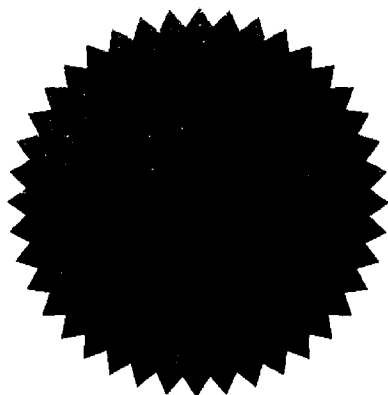
**Description of Type Design Change:**

Survey Modification

**Installation/Operating Data,  
Required Equipment and Limitations:**

- 1) Install survey Modification in accordance with JCM Aerodesign Limited dwg JCM-003045, Rev. D, or later approved revision.
- 2) The modified rotorcraft must be operated in accordance with Flight Manual Supplement 003045FMS, Issue 1, dated May 22, 2001 or later approved revision.
- 3) The survey modification must be maintained in accordance with Instructions For Continued Airworthiness 003045ICA, Issue 1, dated May 22, 2001, or later approved revision.
- 4) The limitations contained in 003045FMS and 003045ICA are mandatory.

-- End --



**Conditions:** This approval is only applicable to the type/model of aeronautical product specified therein. Prior to incorporating this modification, the installer shall establish that the interrelationship between this change and any other modification(s) incorporated **will not** adversely affect the airworthiness of the modified product.

D. Phillips  
For Minister of Transport



United States of America  
Department of Transportation -- Federal Aviation Administration

# Supplemental Type Certificate

IMPORT

*Number* SR01367NY

*This certificate issued to* JCM Aerodesign Limited  
P.O. Box 415  
Peterborough Ontario K9J 6Z3  
Canada

*certifies that the change in the type design for the following product with the limitations and conditions therefor as specified herein meets the airworthiness requirements of Part 6 of the Civil Air Regulations.*

*Original Product -- Type Certificate Number :* H2SW

*Make :* Bell

*Model :* 206 L, 206 L-1, 206 L-3

*Description of Type Design Change:*

Installation of Survey Modification in accordance with JCM Aerodesign Limited Drawing JCM-003045, Rev. D, dated 5/22/01.

*Limitations and Conditions :*

1. The Transport Canada approved Flight Manual Supplement 003045FMS, Issue 1, dated May 22, 2001 is required with this modification.
2. The Transport Canada approved Instruction for Continued Airworthiness 003045ICA, Issue 1, dated May 22, 2001 is required with this modification
3. Compatibility of this design change with previously approved modifications must be determined by the installer.
4. If the holder agrees to permit another person to use this certificate to alter the product, the holder shall give the other person written evidence of that permission.

*This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.*

*Date of application :* June 13, 2001

*Date reissued :*

*Date of issuance :* July 9, 2001

*Date amended :*



*By direction of the Administrator*

*Raymond H. Steinhardt*  
(Signature)

*for*

Vito A. Pulera  
Manager,  
New York Aircraft Certification Office

(Title)



## **Addendum to Technology Demonstration Plan**

### **MTADS Airborne and Vehicular Survey of Target S1 at Isleta Pueblo**

Although the draft Site Assessment referenced in the Technology Demonstration Plan as reference 16 reports no HE-filled ordnance on Site S1, recent walkovers conducted by Corps of Engineers personnel have made this conclusion less certain. In addition to the heavy-walled fragments shown in Figure 8 of the test plan, these walkovers have also identified base plates on the site that could have come from 1000-lb or 2000-lb bombs. Based on these findings, we have to approach this site as if it is a live site.

This change in status affects the manner in which two of the operations described in the test plan will be conducted. The additional precautions to be taken during the vehicular survey and landmarking are detailed below. The airborne operations are not affected as they are conducted above the ground. The aircraft will not touch down inside the site except in emergency conditions. All refueling and data transfer operations will be conducted South of the site near the MTADS base camp. The remediation operations will be affected by this change in hazard status but they are the subject of a separate test plan being prepared by the remediation contractor, EOTI, Inc.

**Landmarking:** Landmarking involves the use of portable GPS units to record the locations of prominent features on the site that may be of aid to the analysis team. Examples of items to be landmarked are prominent geological features (ravines and washes), man-made features such as the fly-in markers on the site, etc. Because of the change in hazard status, the following additional precautions will be observed during landmarking operations:

All work areas will be visually checked for UXO related objects. The UXO SSO will examine all objects found. No UXO related items will be disturbed until the UXO disposal phase of the operation. The UXO objects will be evaluated by the UXO SSO and marked appropriately as hazardous or non-hazardous materials. All items deemed to be hazardous will be marked with a red flag and all items deemed to be non-hazardous would be marked with a yellow flag. All items deemed to be hazardous and marked as such will have a 5-meter radius exclusion area. This area will not be intruded upon for any reason.

**Vehicular Survey:** The MTADS survey vehicle and magnetometer sensor trailer have been designed to have a lighter footprint than a human. As such, the primary hazard associated with vehicular survey operations is direct impact of the vehicle with a surface or protruding UXO or hazardous fragment. As such, the following procedures will apply:

During MTADS vehicle operations the driver will remain aware of the vehicles track and make certain the path in front of the vehicle is clear. If any hazardous UXO items are in the path of the vehicle, all exclusion areas will be observed.

These revised procedures will be posted in the analysis trailer and discussed at the first morning tailgate safety briefing for each crew.